Saskatchewan
Agriculture
and Food

FINAL REPORT

BUSINESS PLAN FOR CANADIAN PULSE CROP RESEARCH INITIATIVE

20000009

Funded by
Technology Adoption and Demonstration
March 2001

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102-02156/

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Food Industry Consultants

The Saskatchewan Pulse Industry

– A Business Plan and Strategy for Research –

Prepared For:

Saskatchewan Agriculture and Food
Special Crops Committee

Prepared By:

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December, 2000

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The Saskatchewan Pulse Industry

– A Business Plan and Strategy for Research –

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EXECUTIVE SUMMARY

Canada is a leader in high quality pulse production. Canada is the world's largest exporter of peas and lentils and is among the top five exporters of chickpeas and beans. In 1999, pulse production in Canada reached almost $1 billion in value. The pulse crop industry is growing, expanding and actively contributing to the national economy and to the future of Canada's agriculture industry. By the year 2005, pulse crops will account for nearly $1 billion in exports.

Canada leads the world in pea and lentil exports.

Saskatchewan is the principle contributor to the Canadian pulse industry with the greatest acreage of peas, lentils and chickpeas grown within the provincial boundaries. Major benefits and industry opportunities are available to the province over the next several decades through the production and marketing of pulse crops. This report addresses the requirements of the industry, with respect to research and development, as it works toward realizing the value of these opportunities.

Two projected outputs anticipated:

- **Letter of Intent (CFI)**
- **Pulse Strategy and Business Plan**

Project Objectives

This important research project was launched in May, 2000 with two key project deliverables anticipated. The first output was a Letter of Intent, to be submitted to the University of Saskatchewan by mid-July. This Letter of Intent would be used to advance an application for pulse research funding to the Canadian Foundation for Innovation, (CFI). Harvest Foods worked with research representatives at the University collecting and collating research plans and lists of required materials. Several meetings were held with eight different research groups and with the director of the Crop Development Centre, Rick Holm, during the of the pulse industry, (growers, researchers, marketers, processors, policy makers).

Chapters 2, 3 and 4 summarize valuable production and market information, providing the context for the 5th chapter which outlines several strategic actions for consideration in future pulse research.

Saskatchewan's Performance and Future in the Pulse Industry

Over the past decade, the Saskatchewan Pulse Industry has grown rapidly, from 380,000 acres of production in 1989 to 4,078,000 acres in the year 2000. Pulse crops such as peas, lentils, chickpeas and beans, have provided Saskatchewan farmers with a profitable option at a time when other cereal grains and oilseeds have experienced declines in value.

The future potential for pulse crops is favourable:
- **expanding markets**
- **environmental benefits**
- **enhancements to the rural economy**

Pulse crops have performed well historically, but more importantly, the future potential for pulse crop production in Saskatchewan looks extremely favorable. Saskatchewan has the appropriate agronomic conditions to produce high quality, cost-effective pulse crops. The province has a large, semi-arid area with soils and climate that are well suited for expanded pulse production. Pulse crop research has enhanced the province's capability to compete in the international market for pulse crops through new varieties, improved plant pathology, biotechnology, and agronomics. Rural Saskatchewan has embraced the opportunity to advance the pulse industry through approximately 130 processing facilities which sort, bag and clean pulse products for the export market.

Saskatchewan's production potential exceeds that of countries where pulse consumption is high, such as India,

Saskatchewan's Pulse Research Strategy

When creating a strategic plan for future research investment in Saskatchewan, there is a great temptation to rely on the experiences and successes of the past. Traditionally, research programs have been designed to utilize the lessons learned through past research endeavours. These lessons build a knowledge base which hopefully will lead to break-through research results. This research philosophy has obvious merits. It is important to learn from past experiences.

Unfortunately, building only on past achievements can result in planning which does not consider global changes in production and marketing. Does the market want what can be produced, regardless of higher yields and good quality? Saskatchewan's historical research emphasis has resulted in improved cereals and oilseeds, however the market demand and price for these commodities has declined. The return on the research investment that is being made in cereal grains and oilseeds continues to decline as well.

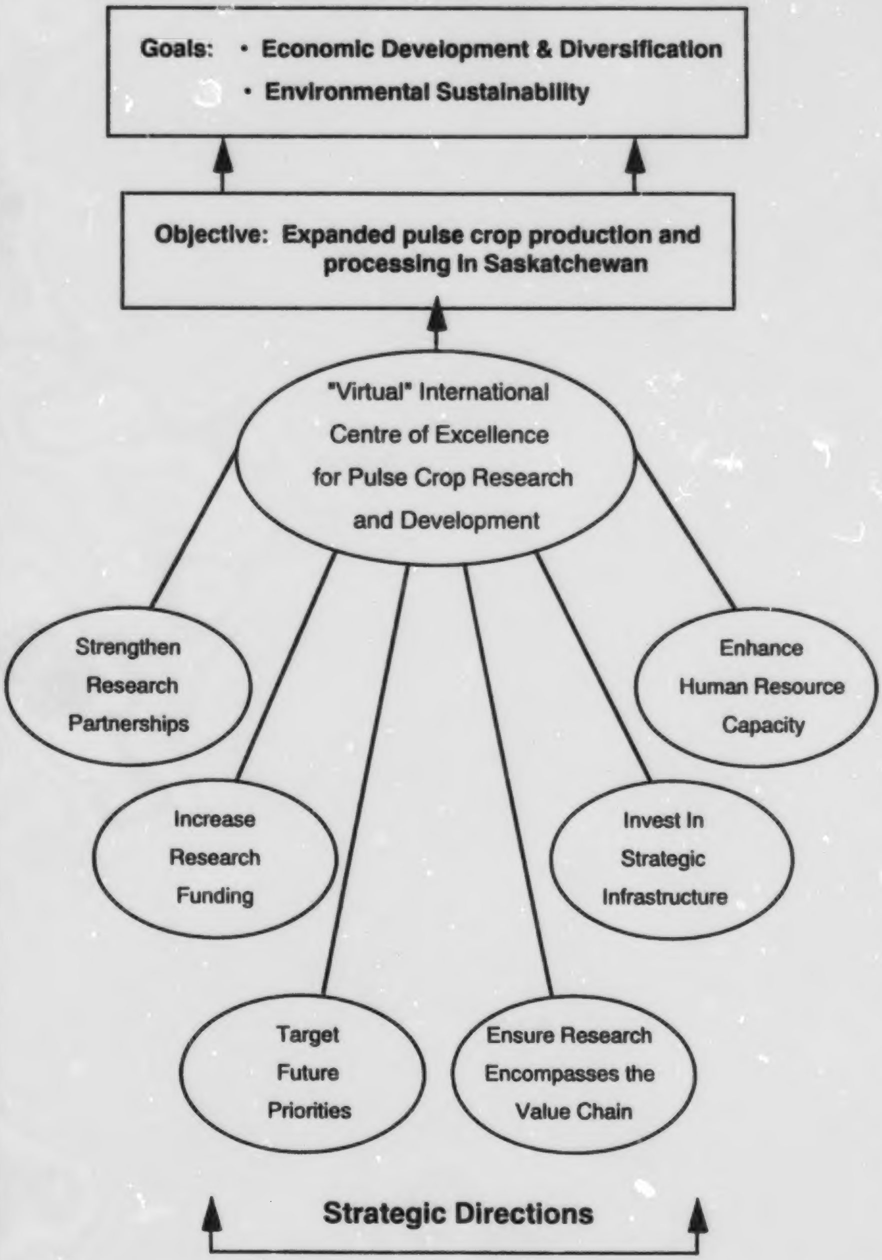
Research strategy must be forward looking.

Future farm cash receipts and production opportunities will depend on the province's ability to find alternative crops which respond to international market demands and embrace the potential of the future. Therefore, it is essential that future research strategy incorporates the best of both historical lessons and futuristic planning.

Research must focus on future-oriented opportunity.

As global production practices shift, there is a need for Saskatchewan and Canada to reconsider how total research dollars are divided. There must be an allocation of resources to the research of emerging crops which offer future diversification opportunities for Saskatchewan producers. What has been successful in the past doesn't matter to the

Figure B Pulse Crop Business Plan Framework


Goals: • Economic Development & Diversification
• Environmental Sustainability
Objective: Expanded pulse crop production and processing in Saskatchewan
"Virtual" International Centre of Excellence for Pulse Crop Research and Development
Strengthen Research Partnerships
Increase Research Funding
Target Future Priorities
Ensure Research Encompasses the Value Chain
Invest In Strategic Infrastructure
Enhance Human Resource Capacity
Strategic Directions

Invest in Strategic Infrastructure to upgrade and modernize Saskatchewan pulse crop research facilities and equipment to world class standards.

Although there have been recent enhancements to PBI, AAFC and U of S facilities, there is still a significant need to advance the infrastructure available to the pulse industry. Greater lab space, better storage, improved processing equipment and advanced technologies are required to move the industry forward.

Enhance Human Resource Capacity by directing public and industry funds towards retention, recruitment, training, and retraining of additional scientific and technical human resources for pulse crop research.

As the pulse industry grows and the research demands increase, there is a need to allocate additional human resources to the research tasks. Strengthened expertise will be needed in plant breeding, plant pathology, genetics, biotechnology, microbiology, nutrition and food science, agronomy, engineering and economics (transportation and marketing). It is anticipated that at least a doubling of human resources will be needed within the next five years. It may also require that current scientific staff retrain to focus their efforts on the future value found in the pulse industry.

Ensure That Pulse Resources Encompass All Aspects of the Value Chain from breeding and genetic improvement activities to human and animal consumptive uses.

Research related to the pulse industry is needed at all levels of the value chain. Of course, research must support

GLOSSARY

AAFC	Agriculture and Agri-Food Canada
AAFCSRCen	Agriculture and Agri-Food Canada, Saskatoon Research Centre
AAFCSRCenCU	AAFC, Saskatoon Research Centre, Crop Utilization
ADF	Agricultural Development Fund
AFIF	Agri-Food Innovation Fund
AgBioEng	Agricultural and Bioresource Engineering
AMFS	Applied Microbiology and Food Science, U of S
BPC	Bio Processing Centre
CDC	Crop Development Centre, U of S
CGC	Canadian Grain Commission
CIGI	Canadian International Grains Institute
FAO	Food and Agriculture Organization
FPP	Fermentation Pilot Plant, SRC
GRL	Grain Research Laboratory, CGC
MMt	Millions of metric tonnes
NRC	National Research Council
PAMI	Prairie Agricultural Machinery Institute
PBI	Plant Biotechnology Institute, NRC
PFRC	Prairie Feed Resource Centre
POS	Protein, Oil and Starch Pilot Plant
SAF	Saskatchewan Agriculture and Food
SFC	Saskatchewan Food Centre
SRC	Saskatchewan Research Council
SRP	Strategic Research Program, ADF
U of S	University of Saskatchewan
USDA	United States Department of Agriculture

1.0 INTRODUCTION

The Saskatchewan pulse crop industry is undergoing significant growth. In the past ten years, Saskatchewan's pulse crop production has grown over 1000% from 380,000 acres in 1989 to 4.078 million acres in 2000.[1] The pulse industry now accounts for approximately 15% of farm cash receipts in Saskatchewan. There are currently 128 special crops processors handling mostly pulse crops in the province employing 1,086 persons.[2]

The main pulse crops currently produced in Saskatchewan are dry peas, lentils, chickpeas, and, to a lesser extent, dry beans. There has been a small production of faba beans in the past and several other species may have potential for future production in the province (e.g., soybeans and lupins).

The tremendous expansion in pulse crop production is the result of several key factors such as favourable crop prices relative to cereals and oilseeds, the adaptation of pulse crop species to Saskatchewan climatic and soil conditions through research and plant breeding, and the willingness of many farmers to diversify.

Continued vibrant growth of the pulse industry necessitates the creation of a coherent, long-term research and development plan which focuses on desired outcomes; increased farm cash receipts, greater diversification, improved GDP, etc. With a goal-oriented strategic plan, an implementation strategy will be required which embraces the future of Saskatchewan agriculture. The pulse industry has demonstrated significant past growth, but more important than its historical performance, is the future potential that the pulse industry offers to the province of Saskatchewan. A futuristic strategy will shift away from the status quo and what has been done in the past. A futuristic strategy will invest in those areas of the agricultural economy with the most future growth potential. The pulse industry represents future opportunity.

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[1] Saskatchewan Agrivision Corporation. November 2000. *Pulse Industry: State of the Industry Fact Sheet.* Saskatoon.

[2] Saskatchewan Pulse Growers. May 2000. *Pulses: A Saskatchewan Success Story.* Saskatoon.

1.1 Project Background

This research project originally began as an effort to develop an application for funding for the Canadian Foundation for Innovation (CFI). There is a consensus around the need to advance the pulse industry through expanded research and development work. Therefore, the University of Saskatchewan, with support from the Government of Saskatchewan, initiated a research project to explore the potential for an International Pulse Research Institute with capital expenses covered by CFI. The provincial business plan and pulse development strategy would then be created and attached to the CFI proposal as support documentation in order to secure the funding.

The mandate of CFI is to increase the capability of Canadian universities, colleges, hospitals and other eligible institutions to carry out world-class scientific research and technology development. The CFI promotes innovation by investing in research infrastructure with joint funding partners. For the CFI, innovation is a process that begins with the creation of knowledge in research and continues through its applications - for the benefit of Canadian society.[3]

Through the process of creating a Letter of Intent for the University of Saskatchewan to use in their CFI application process, it became apparent that the vision for a Pulse Research Institute may not need the requirements of the CFI program. In addition, the application and project selection process of CFI was designed to take up to 24 months. The pulse industry wanted to move research activities forward more quickly. Therefore, the CFI application procedure was abandoned in the fall, 2000.

Without the CFI application requirement, the focus for the remaining portion of the report has been on the development of a business plan and strategy for the pulse industry. In particular, the government of Saskatchewan wants to plan its future commitment to the industry. This document will provide a background of information that will facilitate this decision process.

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[3] Canada Foundation for Innovation Website, October, 1999. *Policy and Program Guide.* <www.innovation.ca>

1.2 Purpose of This Report

The purpose of this report is to outline the principle elements of a strategic business plan for future pulse crop research in Saskatchewan. The strategy covers a period of five to ten years into the future.

The business plan developed in this report is intended to assist SAF in establishing its research funding focus and priorities for pulse crops. A principle goal of SAF is how to maximize the contribution of research and development to support future growth of the pulse crop industry in Saskatchewan. In particular, the following questions are addressed in the development of the research business plan:

1. What are the research needs of the Saskatchewan pulse industry?
2. What are the views regarding future opportunities by various pulse segments (peas, lentils, chickpeas, beans)?
3. Does it make sense to invest in the Saskatchewan pulse industry through future research dollars?
4. What are the common themes for expanding the pulse industry among: Pulse growers? . . . Pulse marketers? . . . Pulse researchers?
5. What is required (financial resources, human resources and infrastructure resources) to respond to the research needs and themes that emerge from the research?

The overall thrust of the plan is consistent with industry views on the future of pulse crop research in the province. For example, the Saskatchewan Pulse Growers have stated that the pulse crop industry needs increased research and development investment to achieve its future potential.[4]

The Saskatchewan Pulse Growers have joined with other pulse industry participants from across Canada to form Pulse Canada Research (formerly known as 'Canadian Pulse Crop Research Initiative'). Saskatchewan Agriculture and Food (SAF) is one of the participants in this initiative. The vision for Pulse Canada Research is "to increase the international competitiveness of the Canadian pulse industry by enhancing national research capabilities and developing strategic research policy."[5] A national pulse crop research strategy will be developed under the Pulse Canada initiative during the 2000/01 crop year (August 1 – July 31).

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[4] Patterson, Garth. 2000. *Global Opportunities for Pulses*, Saskatchewan Pulse Crop Development Board, Saskatoon, October 2000.

1.3 Framework for Developing the Plan

The framework for development of the business plan involves the use of two concepts – the pulse crop value chain and the research and development continuum. These concepts are described in the following sections.

1.3.1 The Pulse Crop Value Chain

The focus of the business plan is on future strategic directions, priorities and roles for research needed to help the Saskatchewan pulse industry achieve its potential. The value chain is a useful concept for thinking about the value-added linkages and relationships among various stages of production and processing of pulse crops.

Figure 1-1 illustrates a value chain for Saskatchewan pulse crops moving from genetic improvement through to the creation of valuable products for consumptive uses as food, feed and non-food products in various domestic and export markets. The value chain concept helps visualize where and how the focus of research efforts may evolve over time to facilitate the application of science to the production and use of plant material.

In this report, we have given consideration to data collection all along this value chain, from farm breeding to consumptive uses.

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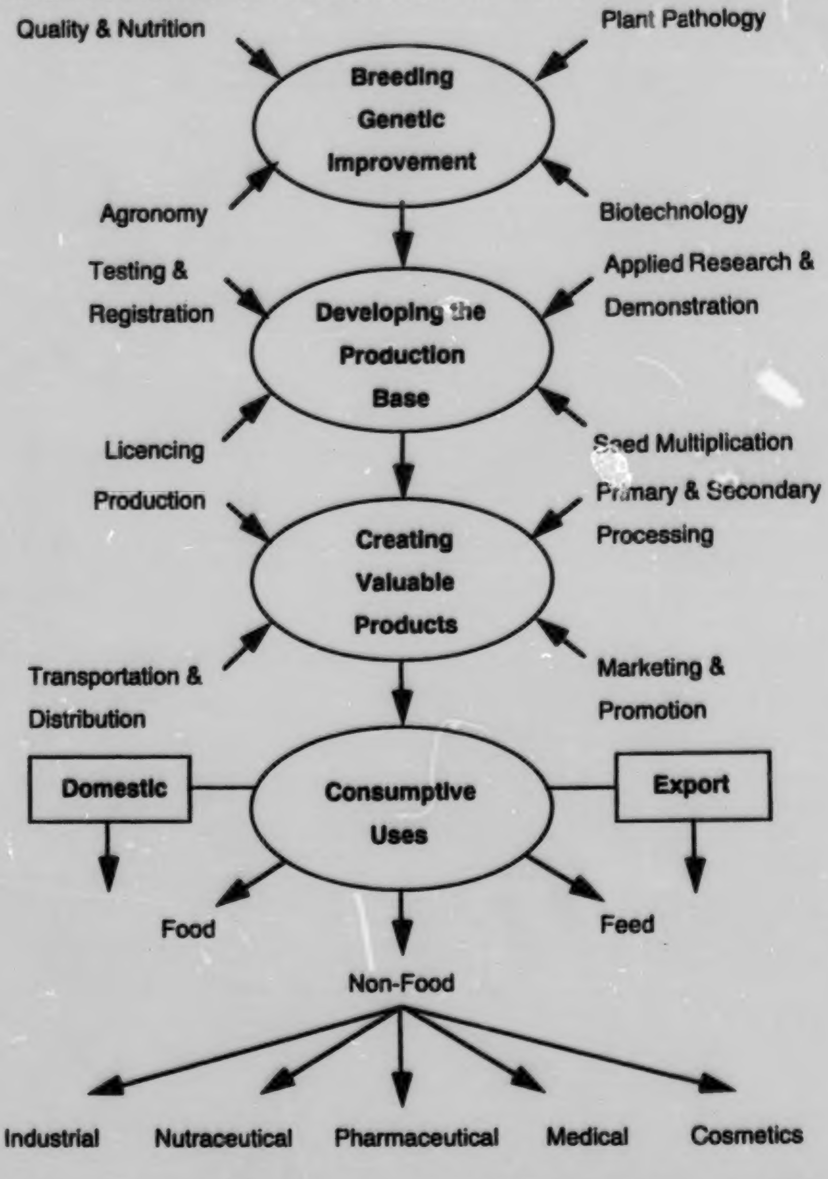
[5] Minogue, Lyle. 2000. Pulse Canada Research, Third Pulse Crop Research Workshop, Winnipeg, November 19-21, 2000.

Figure 1-1 Saskatchewan Pulse Crop Value Chain


Quality & Nutrition
Plant Pathology
Breeding
Genetic
Improvement
Agronomy
Biotechnology
Testing &
Registration
Applied Research &
Demonstration
Developing the
Production
Base
Licencing
Seed Multiplication
Production
Primary & Secondary
Processing
Creating
Valuable
Products
Transportation &
Distribution
Marketing &
Promotion
Domestic
Consumptive
Uses
Export
Food
Feed
Non-Food
Industrial
Nutraceutical
Pharmaceutical
Medical
Cosmetics

Evolved from discussions with Bert Vandenberg, CDC, U of S, Saskatoon, November 2000.

1.3.2 Research and Development Continuum

Scientific research and development is often thought of as a continuum of activities from basic research on an idea through to commercialization of the idea.[6] An example of this type of thinking is the work done by PAMI, AgBioEng and POS to help clarify their respective roles in crops research and development.[7] Figure 1-2 demonstrates the concept of a research and development continuum. The four key stages of research and development are illustrated beginning with basic research, moving to applied research, followed by field testing and/or pilot plant applications, through to the initial stage of commercialization.

Figure 1-2 Research and Development Continuum

Basic Research → **Applied Research** → **Testing & Pilot Plant** → **Commercial Development**

This report employs the following definitions of the research and development stages as they relate to pulse crops within the Saskatchewan context.

Basic Research – The search for and discovery of new knowledge about fundamental scientific principles, characteristics, processes and techniques potentially applicable to pulse crops. The activities focus on basic science disciplines such as biology, chemistry, physics, biochemistry, microbiology, molecular genetics, biotechnology and engineering.

Applied Research – The application of scientific principles and knowledge to the processes for changing and evolving pulse crops and to the development of new products. It involves creating solutions to problems that limit the production, processing and marketing of Saskatchewan pulse crops. Examples of activities include plant breeding, quality evaluation and processing development.

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[6] National Research Council. November 1995. *PBI Update*, PBI Bulletin. Plant Biotechnology Institute, Saskatoon, pp. 8 - 12.

[7] Wasserman, Jim and Shahab Sokhansanj. October 2000. *Crops Processing Development Linkages* and personal communications. Saskatoon: Prairie Agricultural Machinery Institute, Agricultural and Bioresource Engineering, University of Saskatchewan and POS Pilot Plant, Saskatoon.

Testing and Pilot Plant Applications – The verification of pulse crop and processed product characteristics and functionalities beyond the laboratory stage. This stage also includes specification of production or operational parameters essential for technical and economic feasibility. Examples include field-testing of new pulse crop cultivars, agronomic research trials and scale-up of value added processes.

Commercial Development – The final development work needed for commercialization of new pulse crops and processed products. Activities at this stage tend to focus on operational problem solving with reference as needed back to the underlying research and development data. Examples include release of new varieties for seed multiplication and commercial production, the transfer of production technologies through agronomic demonstrations as well as start-up of commercial facilities for primary, secondary and final product processing.

In its fundamental form the research and development continuum is linear although not all ideas at the basic research level end up with commercialization. In reality, the process is much more complex and interactive. More recent writing describes a dynamic process with innovation occurring at any point on the continuum.[8] As ideas evolve from one stage of research to another, for example, problems are encountered which require a return to previous steps in the process. Other ideas fall off the continuum along the way as further research demonstrates their non-feasibility from technical or economic perspectives.

The concept of a research and development continuum is a useful framework for thinking about the approach to existing pulse crop research and where emphasis ought to be focused in the future to maximize the benefits for the pulse crop industry and the province.

In future, research in the pulse industry must consider each element of the research and development continuum.

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[8] Doern, G.B. Fall, 2000. The National Research Council of Canada: Institutional Change for an Era of Innovation Policy, *Canadian Public Administration*, 43(3): 273.

1.4 Methodology Used to Create the Plan

Following initial meetings with representatives of SAF, the Saskatchewan Pulse Growers and several organizations involved with pulse crop research in Saskatchewan, the methodology for this project was revised and finalized. The methodology for creating the proposed business plan consisted of four key tasks as outlined in Figure 1-3.

The tasks conducted were literature review, data collection, interviews and analysis/synthesis.

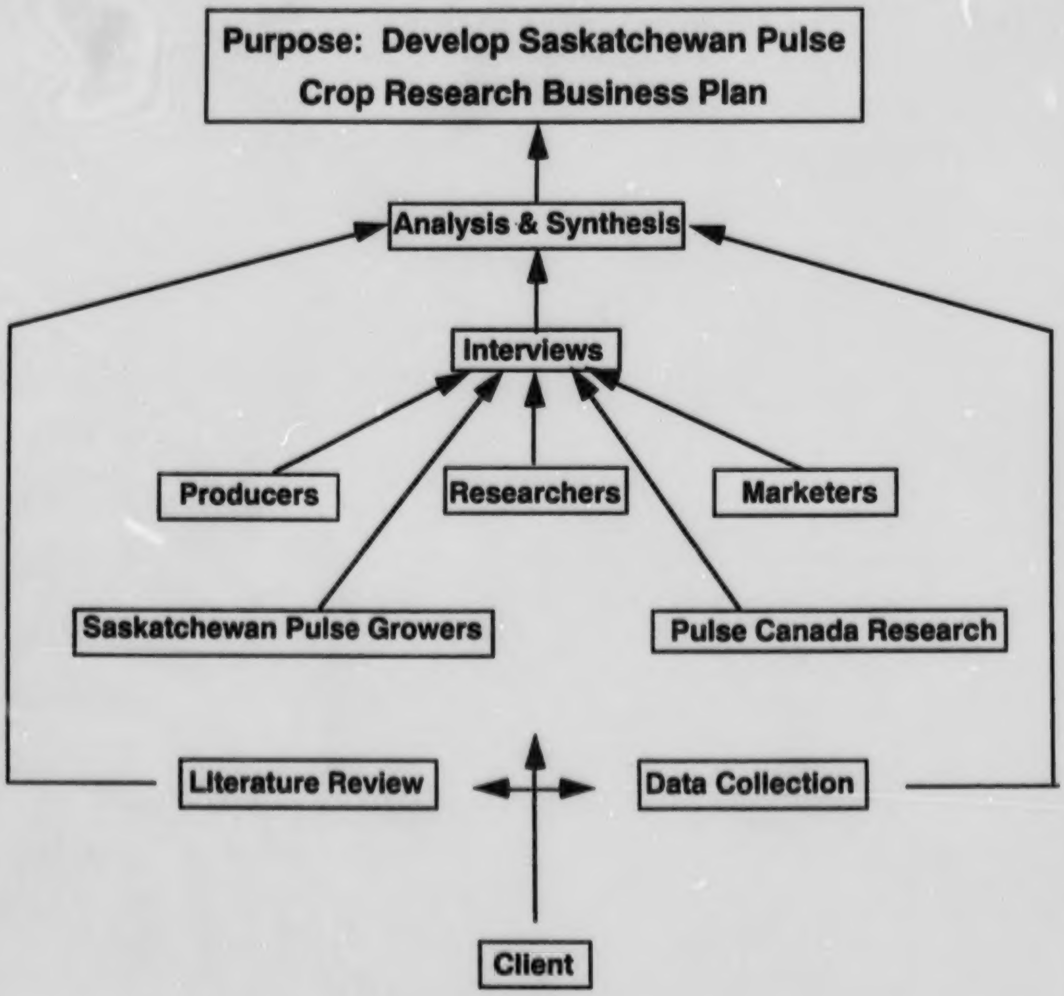
1.4.1 Literature Review

A search was conducted for relevant reference reports and background documents pertaining to pulse crop production, marketing and research in Saskatchewan, Canada and other countries. The primary documents used in preparing this report are listed in the reference section and acknowledgement is noted in the text where a specific source is used.

1.4.2 Data Collection

The principle sources of statistical data on pulse crop acreage, yield, production and trade were the FAO, Statistics Canada, the Market Analysis Division of AAFC and SAF. Data were compiled and presented in graphic format in the body of the report to illustrate Saskatchewan pulse crop industry trends within a Canadian and global context. The data used to create the graphic material are also presented in tabular format in Appendix A.

Figure 1-3 Methodology Logic Framework


Purpose: Develop Saskatchewan Pulse Crop Research Business Plan
Analysis & Synthesis
Interviews
Producers
Researchers
Marketers
Saskatchewan Pulse Growers
Pulse Canada Research
Literature Review
Data Collection
Client

1.4.3 Interviews

A targeted interview process was designed to solicit information that was critical to addressing the primary elements of the business plan. An interview guide was created containing a series of questions to compile a cross section of information related to the pulse industry and to future pulse crop research priorities.

The questions were prepared on the basis of information and issues identified during preliminary discussions with U of S researchers and SAF staff members considering, as well, information collected through the literature review and data collection processes. The questions were pre-tested during several initial interviews, revised as required and finalized. Not all questions were asked in every interview. Generally, only those questions relevant to the particular focus and expertise of each interviewee were used. However, efforts were made to ask every interviewee several questions that related to the orientation, needs and priorities for future pulse crop research. The interview guide is contained in Appendix B.

An interview sample was selected that would consist of those individuals considered most likely to be able to share knowledge, expertise and perspective on their particular component of the pulse industry, as well as implications for pulse research. Interviews were conducted with researchers, marketers, and producers as well as key industry organization and government officials.

Persons selected in each category were asked about their thoughts on pulse crop research needs and priorities. Common trends and themes emerging from the interviews were identified as well as any significant differences in thinking among interviewees. A total of 38 interviews were conducted. The list of individuals interviewed is as follows, in Table 1-1.

Table 1-1 List of Interviewees

Researchers	
Rick Holm	Director, Crop Development Centre, University of Saskatchewan, Saskatoon
Bert Vandenberg	Pulse Crop Breeder and Pulse Crop Chair, Crop Development Centre, University of Saskatchewan, Saskatoon
Tom Warkentin	Pulse Crop Breeder, Crop Development Centre, University of Saskatchewan, Saskatoon
Sabine Bonniza	Plant Pathologist, Crop Development Centre, University of Saskatchewan, Saskatoon
Gene Arganosa	Research Officer, Crop Development Centre, University of Saskatchewan, Saskatoon
Bob Tyler	Professor and Head, Department of Applied Microbiology and Food Science, University of Saskatchewan, Saskatoon
Shahab Sokhansanj	Professor Postharvest Systems, Agricultural and Bioresource Engineering, University of Saskatchewan, Saskatoon
Lope Tabil	Assistant Professor, Department of Agricultural and Bioresource Engineering, Saskatoon
Vern Racz	Executive Director, Prairie Feed Resource Centre, University of Saskatchewan, Saskatoon
Guy Lafond	Research Scientist, Agriculture and Agri-Food Canada, Research Farm, Indian Head
John Mahon	Research Scientist, Plant Biotechnology Institute, National Research Council, Saskatoon
Louise Nelson	Research Scientist (Interviewed during the CFI proposal preparation)
Fran Walley	(Interviewed during the CFI proposal preparation)
Steve Shirtliffe	(Interviewed during the CFI proposal preparation)
Rosalind Ball	(Interviewed during the CFI proposal preparation)
Richard Gray	Director, Centre for Studies in Agriculture, Law and the Environment, University of Saskatchewan
Marketers	
Lawrence Yakielashek	General Manager and Vice-President, Alfred C. Toepfer (Canada) Ltd., Winnipeg
Marlene Boersch	Executive Vice-President, Berdex Canada Ltd., Winnipeg and Chair, Pulse Canada, Winnipeg
Rob Tisdale	Manager, Special Crops, Xcan Grain Pool Ltd., Winnipeg
Dave Walker	President, Walker Seeds Ltd., Tisdale

Table 1-1 List of Interviewees, continued

Producers	
Lyle Minogue	Saskatchewan Pulse Crop Growers, Lacadena
Glenn Annand	Saskatchewan Pulse Crop Growers, Mossbank
Shawn Buhr	Saskatchewan Pulse Crop Growers, Lucky Lake
Processors	
Mark Pickard	General Manager, Infra-Ready Products (1998) Ltd.
Ken Fulcher	General Manager, Parheim Foods Ltd.
Industry Organizations	
Francois Catellier	Executive Director, Canadian Special Crops Association, Winnipeg
Gordon Bacon	Consultant (formerly President) Pulse Canada, Winnipeg
Garth Patterson	Executive Director, Saskatchewan Pulse Crop Development Board, Saskatoon
Linda Malcolmson	Director of Agri-Food Products, Canadian International Grains Institute, Winnipeg
Dennis Stephens	Acting Executuve Director, Canada Grains Council
Dan Tenner	President, Manitoba Pulse Growers Association, Altona, Manitoba
Dennis Dalton	President, Alberta Pulse Growers Commission, Leduc, Alberta
Federal Government	
Juan Miranda	Market Development Advisor, Special Crops, Market and Industry Services Branch, Agriculture and Agri-Food Canada, Ottawa
Stan Skrypetz	Special Crops Analyst, Market Analysis Division, Strategic Policy Branch, Agriculture and Agri-Food Canada, Winnipeg
Ning Wang	Research Scientist Pulse Crops, Grain Research Laboratory, Canadian Grain Commission, Winnipeg
Provincial Government	
John Buchan	Director, Sustainable Production Branch, Saskatchewan Agriculture and Food, Regina
Bruce Baumann	Special Crops Coordinator, Agriculture Research Branch, Saskatchewan Agriculture and Food, Saskatoon
Ray McVicar	Manager, Special Crops, Sustainable Production Branch, Saskatchewan Agriculture and Food, Regina

1.4.4 Analysis/Synthesis

The draft business plan was developed utilizing a process of data analysis and synthesis. The principle elements of the plan are based on information and data compiled during the literature review, data collection and interview phases of the project.

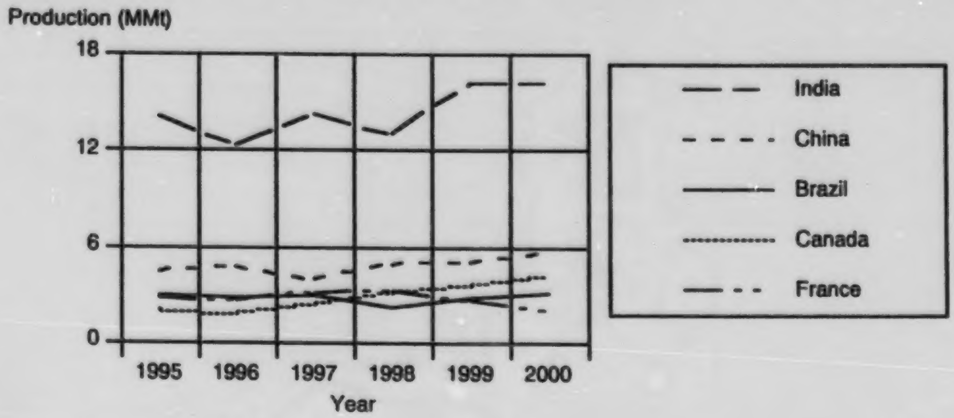
2.0 PRODUCTION OF PULSE CROPS

This chapter addresses global, Canadian and Saskatchewan trends in the production and processing of pulse crops. Key production issues are identified based on interviews with industry participants as well as on implications for pulse crop research priorities in the future.

2.1 Major Producing Countries

Total world production of pulse crops is estimated to be about 60.0 million tonnes in 2000, increasing from about 50.0 million tonnes in 1992.[9] Figure 2-1 illustrates that the top five producing countries, based on average production over the past five years, are India, China, Canada, Brazil and France. Canada's position has increased from fifth in 1997 to third largest in 2000, at about 4.0 million tonnes. Canadian production continues to trend upwards along with India, China and Brazil while production in France is trending downwards.

Figure 2-1 Total Pulse Production, Top Five Producing Countries, 1995 - 2000



Data taken from the FAO Crops Primary, Agricultural Production Database. Website accessed November 27, 2000.

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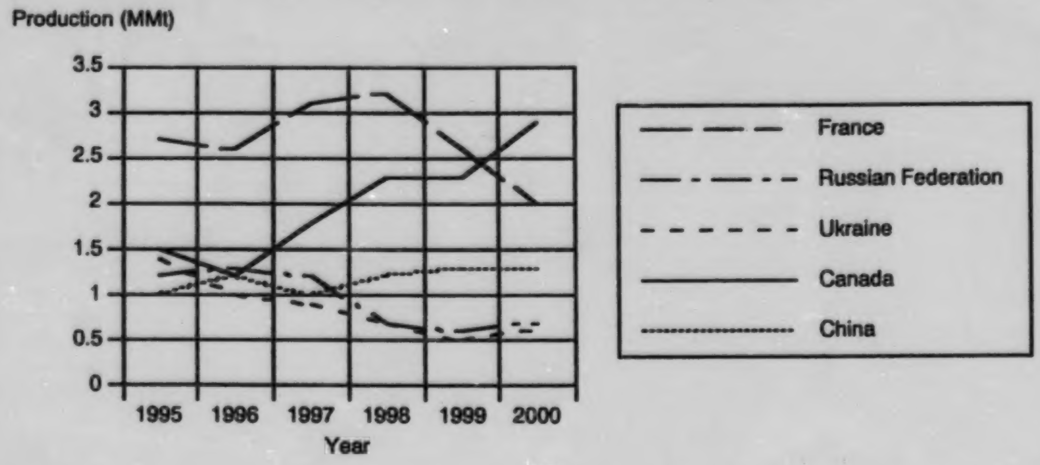
[9] Food and Agriculture Organization of the United Nations. October 27, 2000. FAO Stat Agricultural Data, Crops Primary, Agricultural Production. November 27 and December 8, 2000. <http://apps.fao.org/page/collections?subset= agriculture>

2.1.1 Peas

Global pea production is estimated at about 12.0 million tonnes for 2000, trending down from 17.0 million tonnes in 1990. Figure 2-2 shows Canada for the first time in 2000 to be the top producer of peas in the world at slightly less than 3.0 million tonnes. The next four producing countries based on the past five-year average are France, China, Russia and Ukraine.

There have been significant changes in global production patterns since 1995. Canada has moved sharply upwards from fifth position at about 1.0 million tonnes, while pea production in France has declined significantly since 1998. Production has increased in China but declined in Russia and Ukraine.

Figure 2-2 Pea Production – Top Five Producing Countries, 1995 -2000

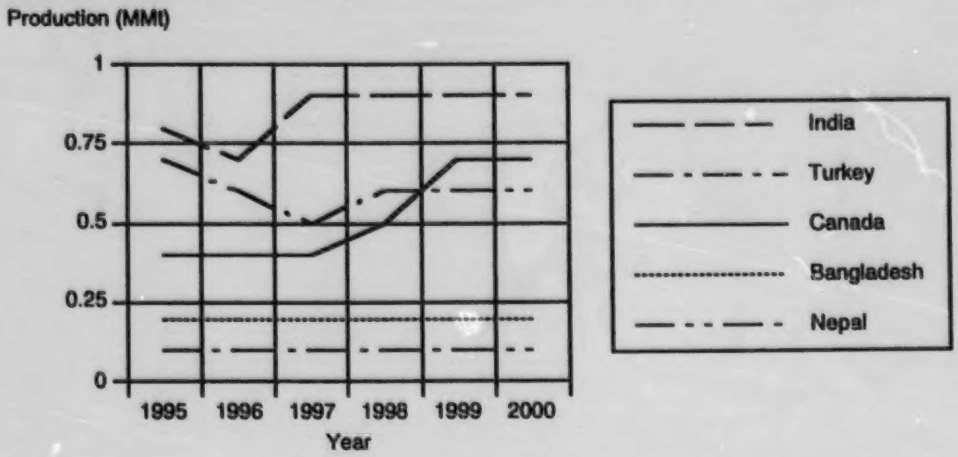


Data taken from the FAO Crops Primary, Agricultural Production Database. Website accessed November 27, 2000.

2.1.2 Lentils

Total world lentil production in 2000 is about 3.3 million tonnes, increasing steadily from about 2.6 million tonnes in 1990. Figure 2-3 indicates that India is the leading lentil producer followed by Canada, Turkey, Bangladesh and Nepal, based on the past five-year average. Canadian production currently stands at about 0.7 million tonnes up from 0.4 million tonnes in 1997. Production remains steady in the other four countries.

Figure 2-3 [illegible] Lentil Production - Top Five Producing Countries, 1995 -2000



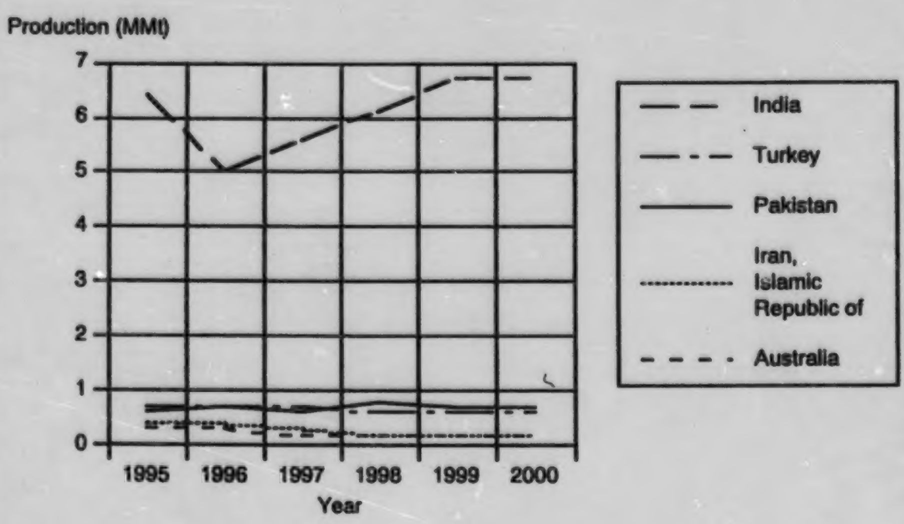
Data taken from the FAO Crops Primary, Agricultural Production Database. Website accessed November 27, 2000.

2.1.3 Chickpeas

World chickpea production has increased from about 7.0 million tonnes in 1990 to 9.4 million tonnes in 2000. Figure 2-4 depicts that the top five producing countries are India, Turkey, Pakistan, Iran and Australia based on average production over the past five years.

Canadian chickpea production does not show in the top five countries. However, acreage has increased from about 100,000 acres in 1998 to 650,000 acres in 2000 and production is soon expected to rival Australia and Iran.

Figure 2-4 Chickpea Production - Top Five Producing Countries, 1995 - 2000

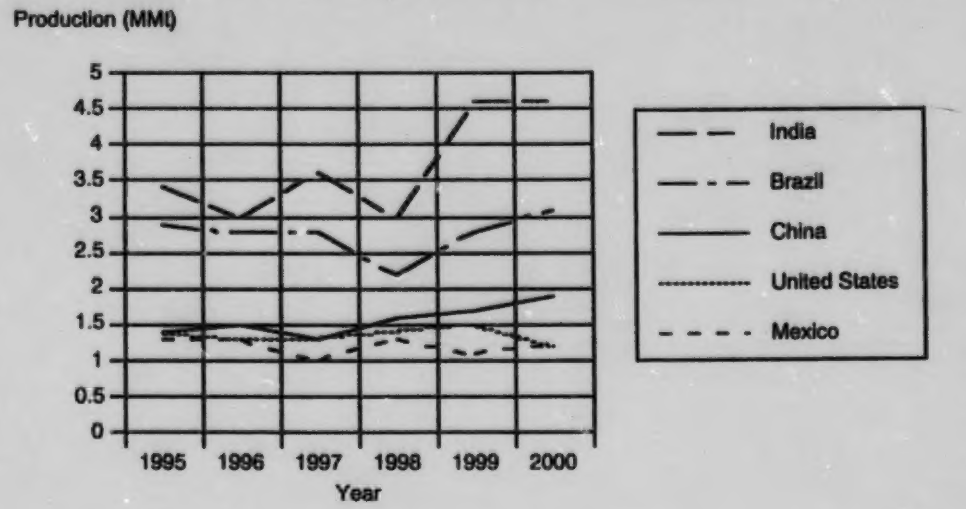


Data taken from the FAO Crops Primary, Agricultural Production Database. Website accessed November 27, 2000.

2.1.4 Beans

Global bean production approached 20.0 million tonnes in 2000, increasing from slightly over 17.0 million tonnes in 1990. Based on the past five year average production, Figure 2-5 illustrates that the top five bean producing countries are India, Brazil, China, United States and Mexico. Canadian production is currently relatively minor although there is potential for growth over the longer term.

Figure 2-5 Bean Production – Top Five Producing Countries, 1995 -2000



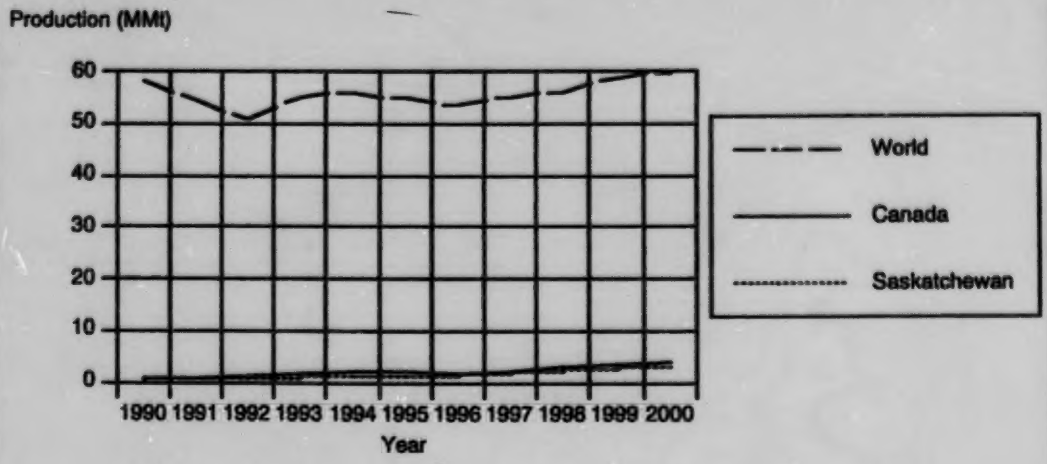
Data taken from the FAO Crops Primary, Agricultural Production Database. Website accessed November 27, 2000.

Current research in bean breeding and production will result in expanded bean production acres. There is significant future potential for bean production in Saskatchewan.

2.2 Saskatchewan's Position in Pulse Crop Production

Although world pulse production fluctuated in the early and mid 1990s, it has shown a steady increase since 1996, as shown in Figure 2-6. While Canada is not a major player in pulse production on a global scale, Saskatchewan is a major player on a national scale. As Figure 2-6 indicates, pulse production in Saskatchewan accounts for a considerable amount of Canadian production.

Figure 2-6 Total Pulse Crop Production – World, Canada, and Saskatchewan, 1990 – 2000



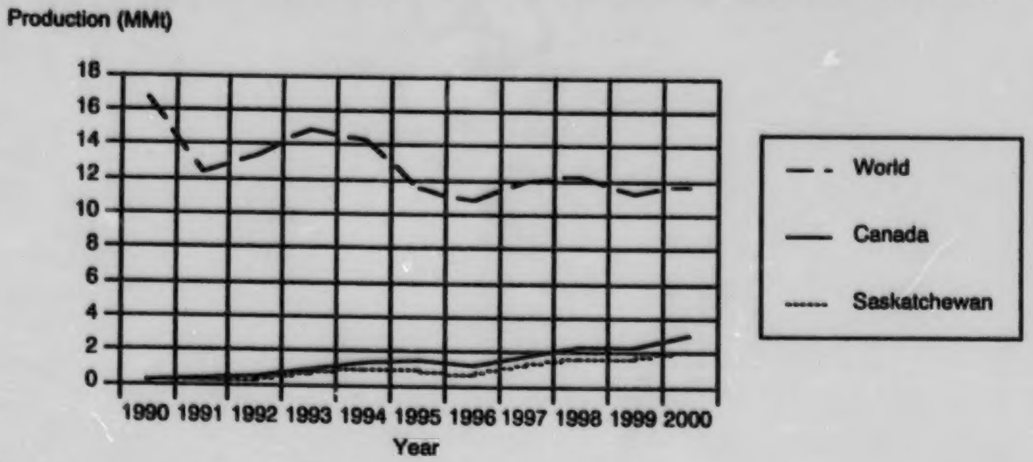
World and Canada statistics from the FAO Crops Primary, Agricultural Production Database. Website accessed November 27, 2000.

Saskatchewan statistics provided by Saskatchewan Agriculture and Food. The total pulse crop production for Saskatchewan was calculated by summing the production values for lentils, peas, chickpeas, beans (coloured) and faba beans in the province.

2.2.1 Peas

Although it has fluctuated throughout the 1990s, world pea production was significantly less in 2000 than it was in 1990, as shown in Figure 2-7. Throughout this time, however, Canadian pea production has steadily increased, accounted for by increased Saskatchewan production.

Figure 2-7: Pea Production – World, Canada, and Saskatchewan, 1990 - 2000



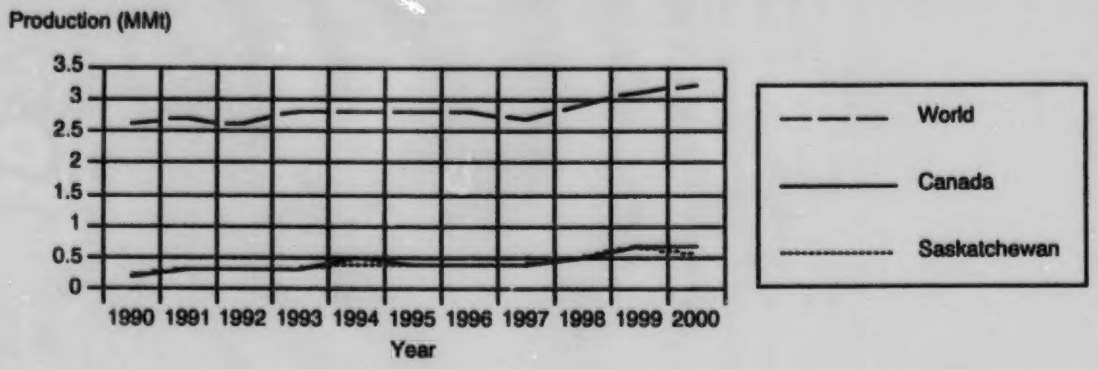
World and Canada statistics from the FAO Crops Primary, Agricultural Production Database. Website accessed November 27, 2000.

Saskatchewan statistics provided by Saskatchewan Agriculture and Food.

2.2.2 Lentils

In contrast to world pea production over the last decade, world lentil production has steadily increased since 1990, with only minor fluctuations. Again, Saskatchewan production of lentils, which has steadily increased over the past ten years, accounts for a large amount of Canadian production, as shown in Figure 2-8. This indicates that Saskatchewan is a major player in lentil production on a national scale.

Figure 2-8 Lentil Production – World, Canada, and Saskatchewan, 1990 – 2000



World and Canada statistics from the FAO Crops Primary, Agricultural Production Database. Website accessed November 27, 2000.

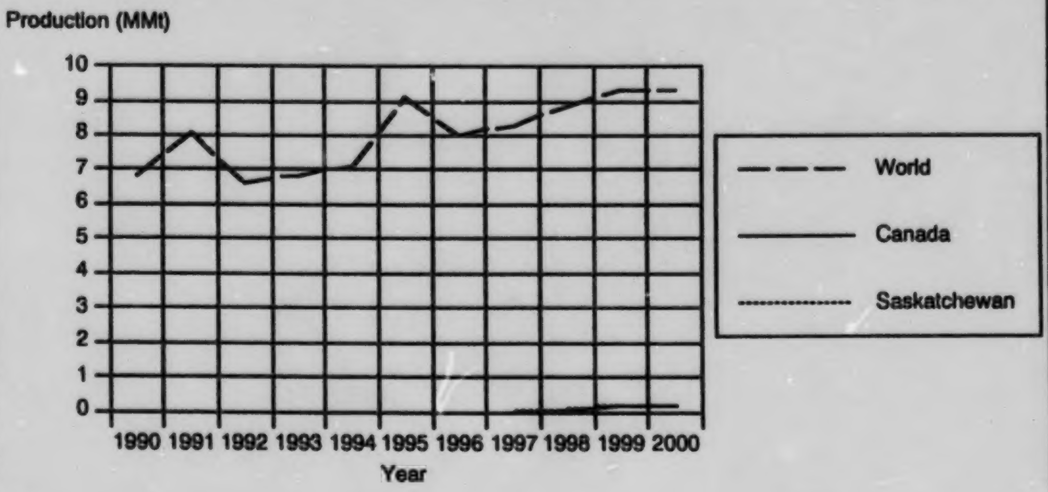
Saskatchewan statistics provided by Saskatchewan Agriculture and Food.

FAO data adjusted to reflect more recent Canadian data for year 2000.

2.2.3 Chickpeas

Although global production of chickpeas has fluctuated throughout the 1990s, it has shown a steady increase, as illustrated in Figure 2-9. Canada, however, has not accounted for much of this production. Until quite recently, Canada did not have any recorded chickpea production, as reported on the FAO site. It then follows that Saskatchewan has not produced chickpeas on the same scale as it has produced other pulse crops, such as lentils, for example. Chickpea production has increased significantly in Saskatchewan since 1998, reflecting a seven-fold increase in acreage.

Figure 2-9 Chickpea Production - World, Canada, and Saskatchewan, 1990 - 2000



World and Canada statistics from the FAO Crops Primary, Agricultural Production Database. Website accessed November 27, 2000.

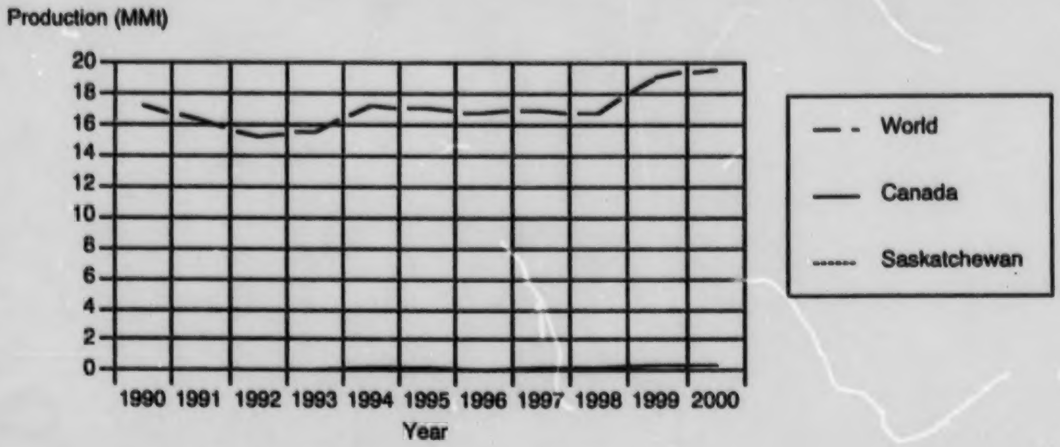
Saskatchewan statistics provided by Saskatchewan Agriculture and Food.

Saskatchewan production represents all of the national chickpea production. Given the size of world demand, this indicates a strong potential for chickpeas.

2.2.4 Beans

World bean production has shown a steady increase. Until recently, Canada, including Saskatchewan, has played only a small role in production, as shown in Figure 2-10. The main dry bean production areas in Canada are southern Ontario, Manitoba and southern Alberta. With the adaptation of some new varieties, bean production may increase in Saskatchewan in the future.

Figure 2-10 Bean Production - World, Canada, and Saskatchewan, 1990 - 2000



World and Canada statistics from the FAO Crops Primary, Agricultural Production Database. Website accessed November 27, 2000.

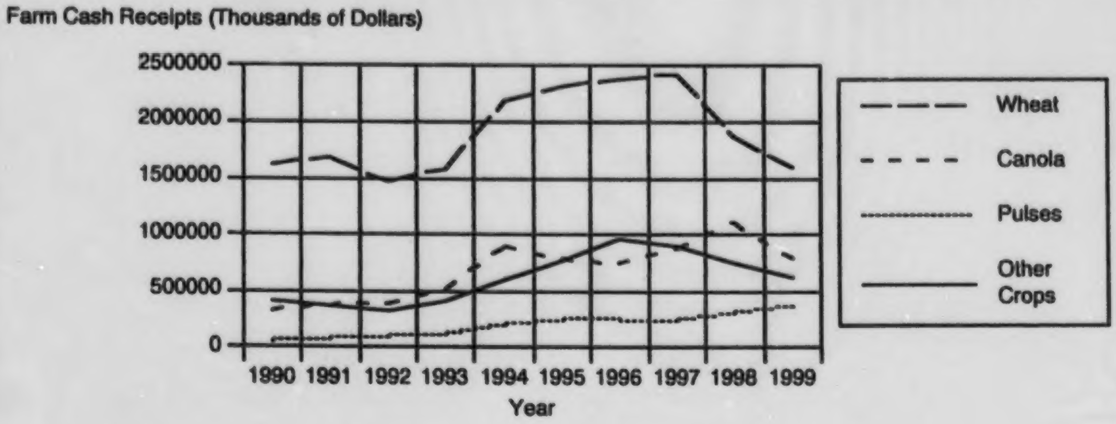
Saskatchewan statistics provided by Saskatchewan Agriculture and Food.

2.3 Contribution of Pulse Crop Production to Saskatchewan

Pulse crop production is becoming an ever more important source of farm income in Saskatchewan in response to significant acreage and production shifts. The 1999 Canadian production value of pulses is estimated to be $930 million growing to nearly $2 billion by 2005, with the majority of production in Saskatchewan.[10]

Figure 2-11 illustrates trends in farm cash receipts in Saskatchewan. Cash receipts from wheat, canola and other crops have declined in the past several years, while Saskatchewan pulses continue to show increases reaching an estimated $500 million in 1999 (incorporates our estimate for chickpeas, currently not included in Statistics Canada Farm Cash Receipts estimates).

Figure 2-11 Farm Cash Receipts, Saskatchewan, 1990 - 1999



Data provided by Saskatchewan Agriculture and Food, Statistics Branch.

Data do not include chickpeas. Farm receipts for chickpeas are currently not tracked by Statistics Canada, which is Saskatchewan Agriculture and Food's source of data.

"Wheat" consists of all wheat classes, including durum. "Pulses" consists of dry peas and lentils. Farm cash receipt data were not available for chick peas or beans. "Other Crops" consists of mustard seed, sunflower seed, canary seed, potatoes, vegetables, strawberries, other berries, grapes, floriculture and nursery, forage and grass seed, hay and clover, forest products, Christmas trees, oats, oats (CWB), barley, barley (CWB), rye, flaxseed, and miscellaneous crops.

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[10] Saskatchewan Agrivision Corporation. November 2000. *Pulse Industry: State of the Industry Fact Sheet.* Saskatoon.

2.4 Processing and Use of Pulse Crops in Saskatchewan

Increased pulse crop production is supporting expansion of primary value added processing. The most common processing activities include cleaning, sorting, grading, bulk loading and bagging. Saskatchewan has 130 special crop processors mostly handling pulse crops. These processors employ over 1,086 persons, a 6% increase since 1995.[11] Employment by special crop processors generates in excess of $21 million in annual wages.[12]

Secondary value-added processing includes precooking pulses and fractionation of starch, protein and fibre for food, feed and fibre markets. Additionally, there is growing use of feed peas in the preparation of livestock feed rations, particularly for swine. Future value added processing may include expanded preparation of flour and separation of components for nutraceuticals and anti-oxidants.

Over $500 million has been invested in the value added special crops processing industry in Saskatchewan. It is estimated that for every one million additional acres of pulse production, over 400 new jobs are created in the handling and processing sector, largely in rural communities.[13]

Our interviews with individuals involved with further processing of pulse crops felt that much more research and development is needed in this area. There are many opportunities to pursue options for further component utilization and product development in order to fully realize the value added potential for pulse crops.

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[11] Ibid.

[12] Patterson, Garth. October 2000. *Global Opportunities for Pulses*, Saskatchewan Pulse Crop Development Board, Saskatoon.

[13] Saskatchewan Agrivision Corporation. op. cit.

2.5 Saskatchewan Pulse Crop Production Issues

This section addresses profitability and competitiveness as key factors explaining why pulse crop production is increasing significantly in Saskatchewan. It also examines potential constraints on production that could impede continued growth in the future. These constraints include Saskatchewan's short growing season, crop yields, diseases, plant structure, agronomics and management practices.

2.5.1 Profitability and Competitive Advantage

Profitability and competitive advantage are two key factors underlying the growth of pulse crop production in Saskatchewan. Despite variability in yields and prices, well-managed pulse crop production has been profitable for Saskatchewan farmers over the past few years and has given them a competitive advantage in global markets.

2.5.1.1 Profitability

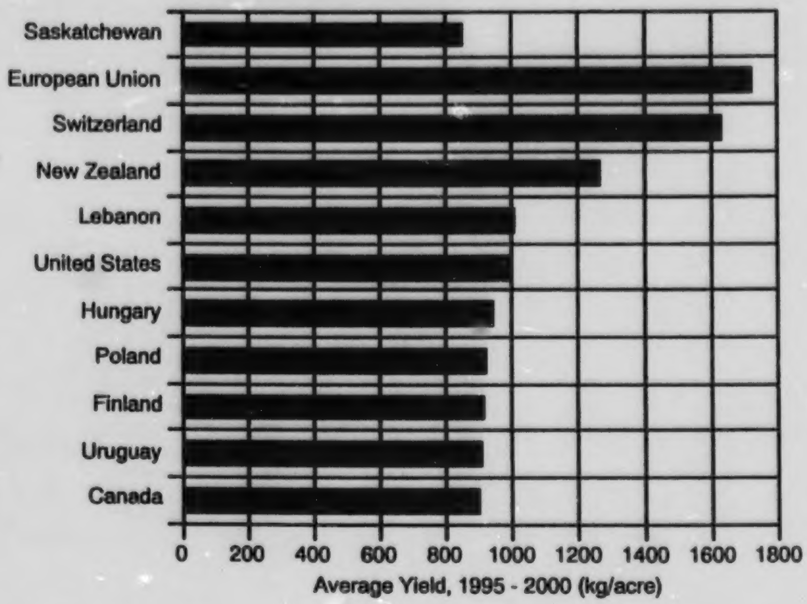
The profitability of pulse crops compares well with the profitability of alternative crops grown in Saskatchewan and fits extremely well from a soil and disease management perspective into cereal, oilseed rotations. While pulse crops typically cost more to produce and have higher yield variability (as reflected in crop insurance premiums) than wheat, prevailing prices have generated higher profits per acre. Our interviews with producers and producer organizations indicate that western Canada, in their view, is now one of the lowest, if not the lowest, cost of production areas in the world for peas, lentils, chickpeas and beans. Low cost of production helps give Saskatchewan a strong competitive edge in pulse crop production.

2.5.2.2 Competitive Advantage

Competitive advantage is enhanced by improved crop yields. Saskatchewan pulse crop yields fall in the mid to high range of global yields. However, Saskatchewan yields have not yet achieved the higher potentials that might be possible compared with yields obtained in several other countries.

For example, Figure 2-12 indicates that Canadian pea yields rank tenth in the world, averaging about 900 kg per acre with Saskatchewan peas averaging slightly less. The highest yields have been obtained by the EU countries with an average of over 1700 kg per acre, almost twice the level of Saskatchewan yields. The next highest yielding countries for peas are Switzerland, New Zealand, Lebanon and the United States.

Figure 2-12 Average Pea Yields, 1995 - 2000

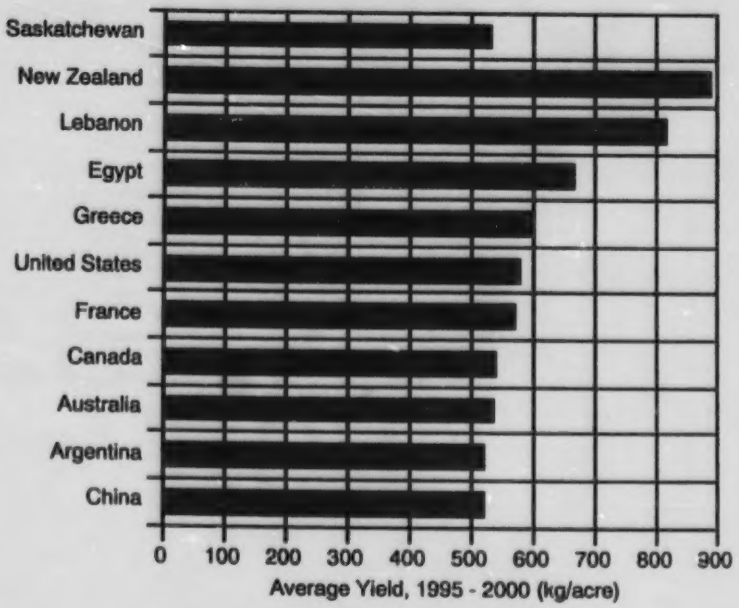


Data (excluding Saskatchewan) taken from the FAO Crops Primary, Agricultural Production Database. Website accessed December 8, 2000.

Saskatchewan data provided by Saskatchewan Agriculture and Food.

Figure 2-13 illustrates that Canadian lentil yields, at about 540 kg per acre, rank seventh in the world. Saskatchewan yields have been almost identical as the province accounts for over 90% of Canadian lentil production. New Zealand yields have averaged the highest in the past six years at almost 900 kg per acre followed by Lebanon, Egypt, Greece and the United States.

Figure 2-13 Average Lentil Yields, 1995 - 2000

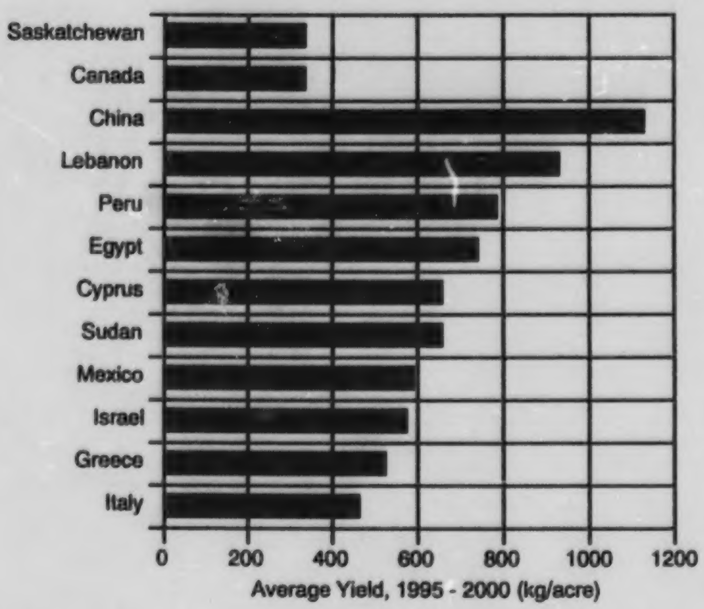


Data (excluding Saskatchewan) taken from the FAO Crops Primary, Agricultural Production Database. Website accessed December 8, 2000.

Saskatchewan data provided by Saskatchewan Agriculture and Food.

Canadian chickpea yields, averaging about 350 kg per acre over the past six years, have not been among the top ten countries. Saskatchewan yields are similar to the Canadian average as the province accounts for over 90% of Canadian chickpea production. Figure 2-14 demonstrates that the highest chickpea yields are obtained by China at an average of over 1100 kg per acre, followed by Lebanon, Peru, Egypt and Cyprus.

Figure 2-14 Average Chickpea Yields, 1995 - 2000

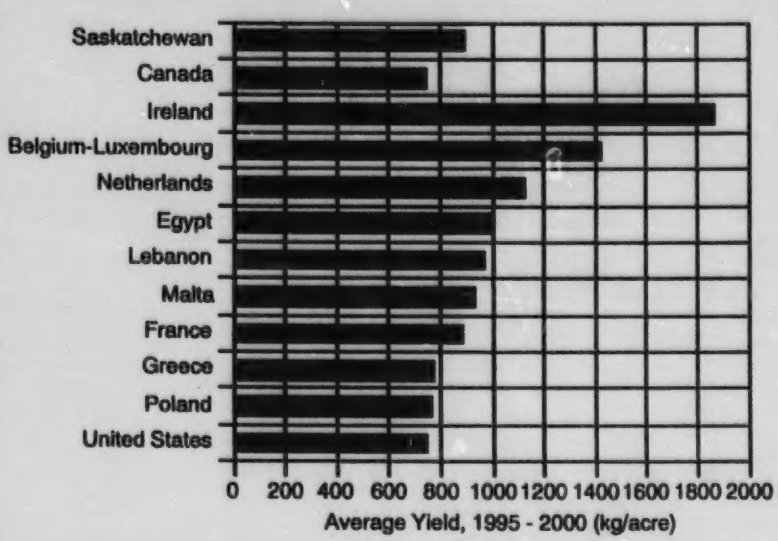


Data (excluding Saskatchewan) taken from the FAO Crops Primary, Agricultural Production Database. Website accessed December 8, 2000.

Saskatchewan data provided by Saskatchewan Agriculture and Food.

Bean yields for Canada average about 750 kg per acre, while Saskatchewan is reported to average slightly higher at almost 900 kg per acre. Figure 2-15 shows Ireland with the highest average yield of over 1800 kg per acre, almost twice the Saskatchewan yield. The next highest yielding countries are Belgium-Luxembourg, Netherlands, Egypt and Lebanon.

Figure 2-15 Average Bean Yields, 1995 - 2000



Data (excluding Saskatchewan) taken from the FAO Crops Primary, Agricultural Production Database. Website accessed December 8, 2000.

Saskatchewan data provided by Saskatchewan Agriculture and Food. Saskatchewan data are from 1997 - 2000 only.

The higher yields obtained by some countries reflect irrigated conditions while semi-arid climatic conditions combined with dry land farming places limitations on potential yield increases in Saskatchewan. At the same time, information obtained during the industry interviews confirmed that the province's semi-arid climate helps to keep pulse crop disease problems in check and, in turn, enhances yields and seed quality.

Overall, many individuals interviewed during this study confirmed that pulse crop production under good management and reasonable prices has in recent years been more profitable for Saskatchewan producers than other cropping alternatives. Several interviewees noted that while Saskatchewan's yields are not as high as the highest in the world, the province's yield disadvantage is partially offset by lower unit input costs, particularly for land, machinery and labour and better seed quality than most competitors.

At the same time, virtually all of our interviewees confirmed that yield is the key production issue to address in the future in order to enhance and maintain Canada's newly realized competitive position and comparative advantage in pulse crops.

2.5.2 Disease and Agronomic Constraints

Besides profitability and competitive advantage based on low production costs, favourable crop yields and sound quality, our interviews revealed that Saskatchewan has better disease control and weed management as well as hardier and earlier maturing crop varieties than many competitors.

Nevertheless, while gains have been achieved in these areas through plant breeding and agronomic research, many constraints remain. It is essential that these key production challenges be addressed to reduce the risks of widespread crop losses in the future as Saskatchewan pulse crop acreage grows.

2.5.3 Comparative Advantage

Our interviews told us that within a global context, Saskatchewan has developed a comparative advantage in pulse crop production compared with other traditional pulse crop producing areas. Saskatchewan's competitive advantage, based on low production costs, is enhanced by the fact that Saskatchewan producers also have a comparative advantage based on crop yields when compared with crop yields in many traditional producing and consuming countries (e.g., Chile, India, Turkey, China, etc.).[14]

We were told, for example, that for lentils, Australia and Canada have yields that are 60 to 70% of wheat yields. Turkey and Syria have yields that are about 50 to 60% of wheat yields while China and India have yields that are 20 to 30% of wheat yields. A similar situation exists for peas where Canada and the United States have yields that are 90 to 100% of wheat yields.

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[14] Patterson, Garth. December 2000. *Personal communication*, Saskatchewan Pulse Growers Association, Saskatoon.

What this means is that it is more economically advantageous for producers in other countries with low pulse yields compared with wheat yields (or compared with rice in China) to switch acreage to the production of these crops and to import more pulses. At the same time, Canadian producers (and Australian producers for lentils or United States producers for peas) potentially gain by switching some wheat acreage (or summerfallow acreage in Saskatchewan's case) to pulse crops.

Examples of how these shifts in production patterns are occurring in practice include Chile and Turkey. Our industry interviews confirmed that Chilean producers are shifting former pulse-growing land to production of higher valued crops, while former lentil-producing land in Turkey is moving under irrigation and increasingly being used for horticulture crops.

In summary, Canada, particularly Saskatchewan, is developing a strong comparative advantage in pulses compared with many traditional producing and consuming areas. This phenomenon enhances Saskatchewan's potential for future expansion of pulse crop acreage as other countries shift some pulse crop acreage to other uses.

2.5.4 Future Production and Land Use Trends

Recent growth in Saskatchewan's pulse crop industry has been dramatic in acreage and production. This growth has reflected a new diversity of crops and varieties adapted to various growing conditions. A wide range of seeds (e.g., colour, size, shape, etc.) are available for an array of customer preferences.

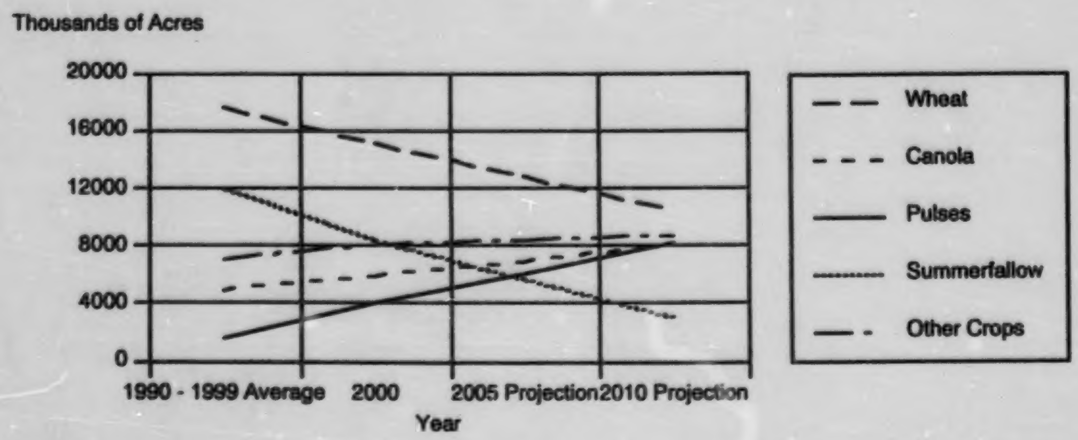
The growth is a consequence of many of the following factors:

- a search by producers for more and better cropping alternatives for the future
- targeted plant breeding as well as critical genetic and agronomic research
- changes in government policy such as elimination of WGTA subsidy that is stimulating increased prairie agricultural diversification

- low profitability of traditional Saskatchewan crops (e.g., wheat, canola)
- development of continuity of pulse crop supply and quality consistency
- proactive pulse crop marketing and market development
- adoption of more sustainable cropping practices, including a drive to reduced summerfallow.

Pulse crops are an integral part of the changing agricultural landscape and land use patterns of Saskatchewan. Figure 2-16 illustrates annual crop and summerfallow acreage (i.e., excludes improved pasture and forage land) for Saskatchewan for the 1990-1999 average, year 2000 and our projections for the years 2005 and 2010.

Figure 2-16 Distribution of Land Use in Saskatchewan, 1995 – 2005



Data for the "1990 - 1999 Average" and "2000" were provided by Saskatchewan Agriculture and Food. The "2005 Projection" and the "2010 Projection" were calculated based on trends seen in land use in Saskatchewan from 1995 to 2000.

For this calculation, "wheat" consisted of winter wheat, spring wheat, and durum. "Pulses" consisted of lentils, dry peas, faba beans, and chickpeas. "Other crops" consisted of oats, barley, fall rye, spring rye, flax, mixed grains, mustard seed, sunflower seed, canary seed, triticale, and safflower.

On average during the 1990-1999 period wheat and summerfallow combined utilized almost 30 million acres, over 70% of the annual cropland area, with pulse crops accounting for less than 2 million acres. Canola and other crops used about 12 million acres.

During this ten-year period, significant acreage shifts were occurring. By the year 2000, the acreage used for wheat and summerfallow together had declined to about 24 million acres, with pulse crops approaching 4.5 million acres. The combined acreage devoted to canola and other crops rose to 14 million acres.

Our projections of the acreage trends during the 1995 to 2000 period suggests a combined wheat and summerfallow acreage of less than 20 million acres in 2005 and less than 15 million acres by 2010. Wheat acreage alone will have declined to about 25% of the annual cropland area by 2010 from about 50% of the area in the early 1990's.

Summerfallow will have declined from over 25% of the area in the early 1990's to less than 10% by 2010. This dramatic decline in summerfallow acreage will only have been possible because of successful, widespread incorporation of pulse crops into crop rotations in the brown and dark brown soil zones of Saskatchewan. This conclusion, of immense environmental and conservation significance for Saskatchewan agriculture and the entire province, is confirmed by interviews with producers and by long-term research results.[15,16]

The vital role of pulse crops in extending crop rotations is seen from our projection that show pulse crops increasing to over 6 million acres by 2005 and to over 8 million acres by 2010. Our projection is in line with another recent forecast.[17] Nevertheless, based on information obtained during our interviews with producers and researchers, these are potentially conservative projections. Several persons interviewed are forecasting, based on recent price strengthening, that Saskatchewan pulse crop acreage may exceed 6 million acres in 2001 and may rival or exceed Saskatchewan canola acreage.

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[15] Biederbeck, V. O. et al. *What Makes the Lentil-Wheat Rotation at Swift Current so Sustainable?* Third Pulse Crop Research Workshop Proceedings, Winnipeg, November 19 – 21, 2000.

[16] Gan, Yantai, Brian McConkey, Bob Zentner. *Soil Water Conservation for Pea, Lentil and Chickpea in the Brown Soil Zone*, Ibid.

[17] Saskatchewan Agrivision Corporation. November 2000. *Pulse Industry: State of the Industry Fact Sheet*, Saskatoon.

Even more striking, some persons interviewed are forecasting that with a concerted plant breeding and research effort, pulse crops could, within ten years, reach what is considered by some scientists to be the annual agronomic limit for Saskatchewan. Based on soil/climatic capability, crop rotation/disease management considerations, variety availability, and favourable market conditions, this limit is currently placed at about 25% of the annual cropland acreage base or 10 to 11 million acres.[18] The feasibility of this potential acreage level was confirmed as well during our interviews with producers.

2.6 Implications for Future Research

From a production perspective, our interviews and research indicate that future pulse crop research goals for Saskatchewan should focus on increasing crop yields, earlier maturity, disease resistance, cold hardiness, sturdier plant architecture and weed control. These goals imply an increased emphasis on plant breeding as well as on the supporting scientific disciplines of plant pathology, genetics, biotechnology and agronomy. Closely linked is the need for research on quality and nutritional characteristics.

Additionally, there are many opportunities to pursue options for increasing research on component utilization and product development in order to fully realize the value added potential for pulse crops in the province.

Overall, we found that production and processing issues have major implications for the direction and emphasis of future pulse crop research and development. There is a need to drive a clear, coherent, integrated action strategy across the complete research and development continuum for pulse crops and through each stage of the pulse crop value chain.

This requires industry visionary leadership, strong partnerships and major new research investment. Any less of an approach for this young, growing, dynamic industry risks truncating the industry before it fully realizes its economic and environmental potential for farmers, rural communities and the province.

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[18] Vandenberg, Bert. December, 2000. *Personal communication*, Crop Development Centre, University of Saskatchewan.

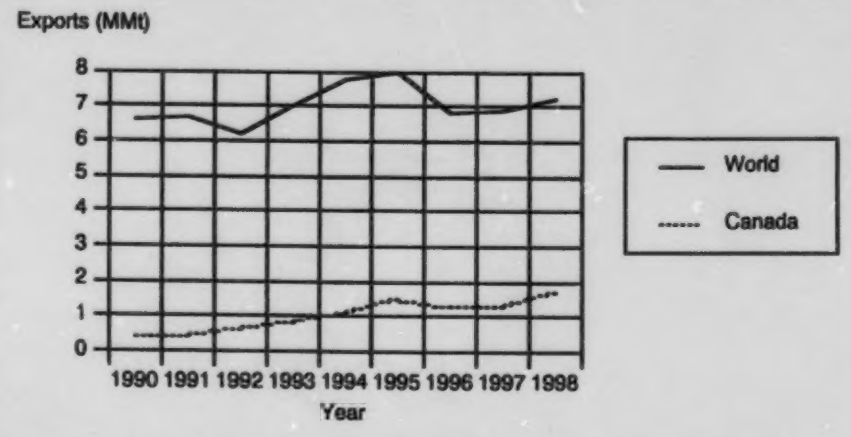
3.0 MARKETING AND TRADE OF PULSE CROPS

This chapter addresses recent global and Canadian marketing, trade and utilization trends in pulse crops, as well as implications for future research directions.

3.1 Global Exports

Trends in global and Canadian exports for pulses in total, as well as for peas, lentils, chickpeas and beans are illustrated in the following figures. Over 60% of pulses produced in Canada are exported and Saskatchewan has over 50% of the pulse crop acreage in North America.[19] Pulse Canada estimates that by 2005, Canada will account for 48% of world pea trade, 63% of world lentil trade and 45% of world chickpea trade.[20]

Figure 3-1 Total Pulse Crop Exports, Canada and the World, 1990 - 1998



Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed November 27, 2000.

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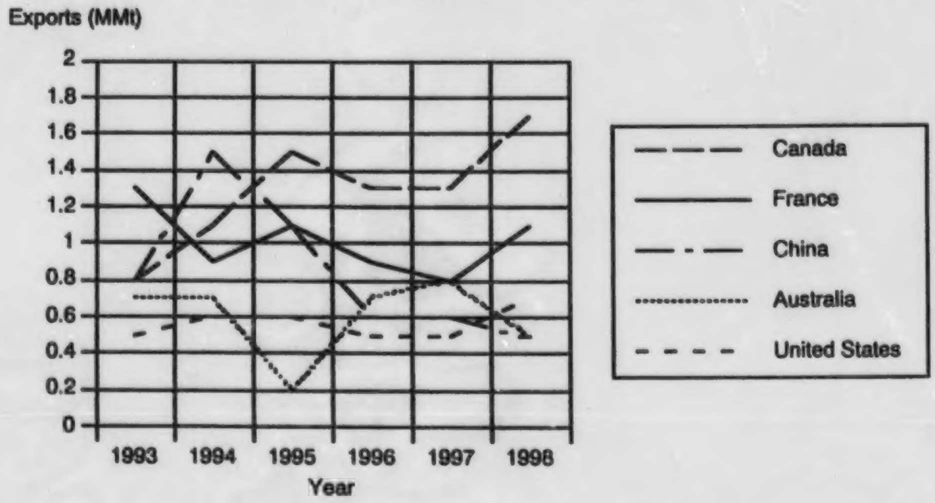
[19] Saskatchewan Agrivision Corporation. op. cit.

[20] Ibid.

Global exports of pulse crops have fluctuated significantly from 1990 to 1998, reaching a peak in 1995, with only a slight net increase in total world exports. Trade declined in 1996, but has been gradually increasing in recent years. However, as shown in Figure 3-1, Canadian exports of pulse crops have steadily increased from 1990 to 1998. Total world trade in all pulses range between 7.0 to 8.0 million metric tonnes, while Canadian exports approached 2.0 million tonnes in 1998, about 25% of total world exports.

As illustrated by Figure 3-2, the top five exporting countries, based on average pulse exports during the 1993 to 1998 period were Canada, France, China, Australia and the United States. By 1998, Chinese exports had fallen and Australia had moved into third place.

Figure 3-2 : Top Five Exporting Countries, Total Pulse Crops, 1993 - 1998

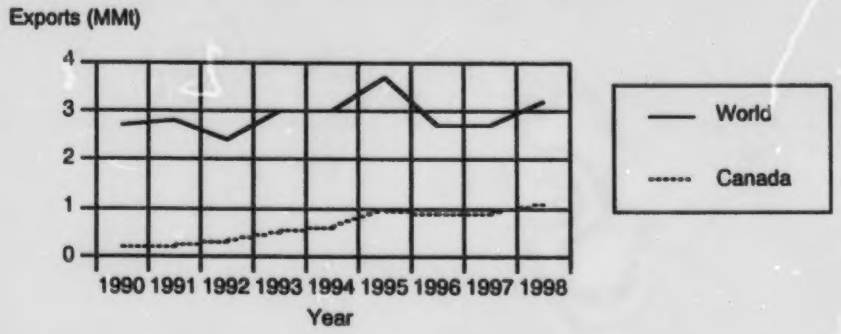


Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed December 6, 2000.

3.1.1 Peas

Global pea exports showed significant shifts in the period from 1990 to 1998 as indicated in Figure 3-3. The net results of these shifts, however, has been an increase in pea exports overall. Canadian pea exports have increased steadily, showing only a minor decrease in the late 1990s before increasing again. Canadian pea exports exceeded 1.0 million tonnes in 1998, representing over 35% of global exports in 1998.

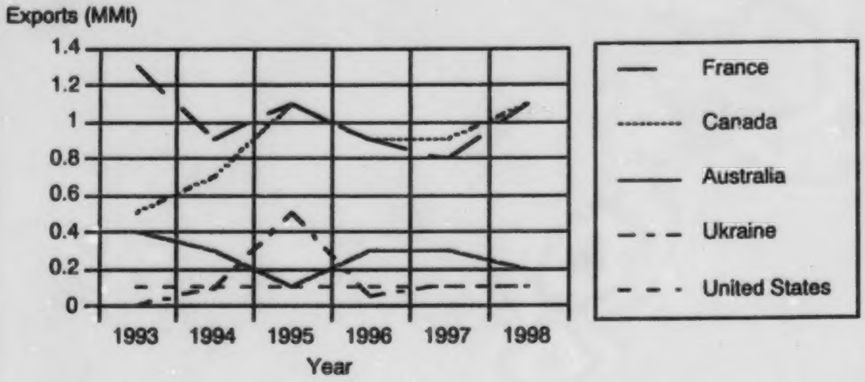
Figure 3-3: Pea Exports, Canada and the World, 1990 - 1998



Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed November 27, 2000.

The top five exporting countries for peas during 1993 to 1998 were France, Canada, Australia, Ukraine and United States as indicated by Figure 3-4. Canadian exports increased during this period, moving from second place to rival France for first place in 1998.

Figure 3-4 Top Five Exporting Countries, Peas, 1993 - 1998

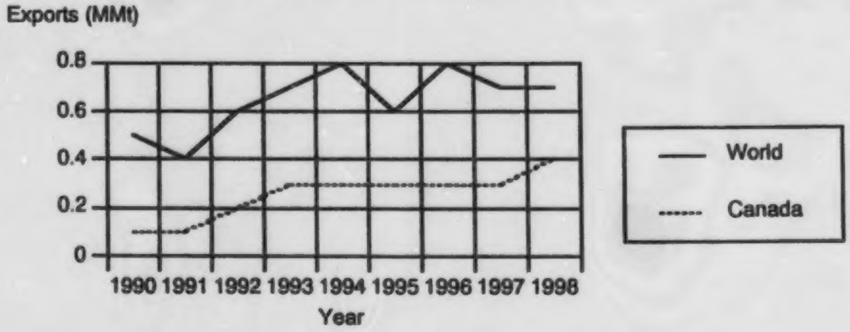


Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed December 6, 2000.

3.1.2 Lentils

World exports of lentils experienced significant fluctuations between 1990 and 1998 as illustrated in Figure 3-5. At the same time, Canadian exports increased steadily, reaching 0.4 million tonnes in 1998. Canadian lentil exports now account for over 55% of world exports.

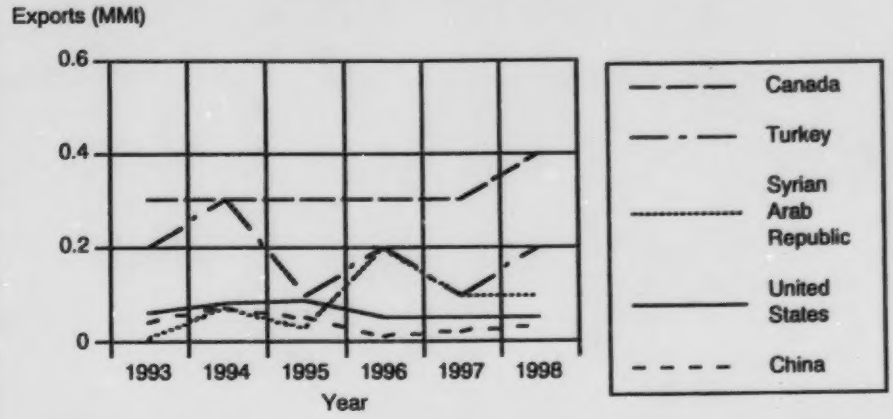
Figure 3-5 Lentil Exports, Canada and the World, 1990 - 1998



Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed November 27, 2000.

Canada remained the top lentil exporting country throughout the 1993 to 1998 period as depicted by Figure 3-6. Turkey, Syria, United States and China followed Canada. Exports from Turkey and Syria were quite variable during the period.

Figure 3-6 Top Five Exporting Countries, Lentils, 1993 - 1998

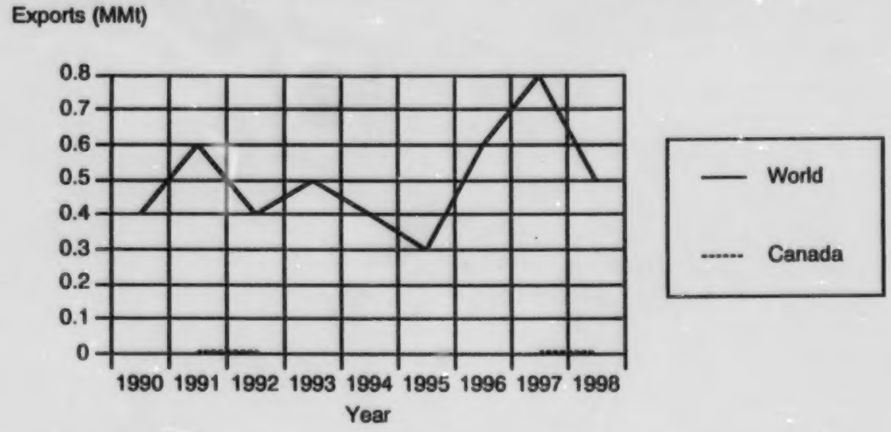


Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed December 6, 2000.

3.1.3 Chickpeas

Global chickpea exports were quite variable from 1990 to 1998 reaching about 0.5 million tonnes in 1998, as noted in Figure 3-7. Canadian exports were not a significant factor during the early 1990s but since 1998 Canadian chickpea acreage has increased seven-fold. Exports are estimated to reach over 0.3 million tonnes in 2000, representing in excess of 50% of world exports in 1998.

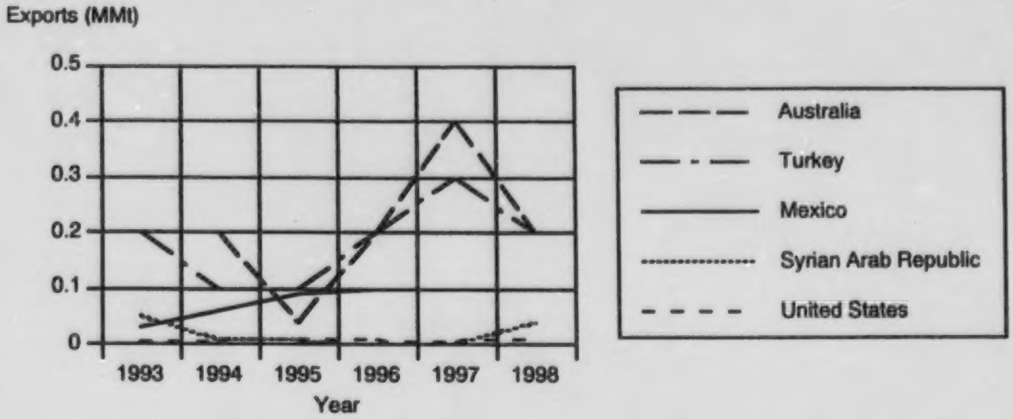
Figure 3-7 Chickpea Exports, Canada and the World, 1990 - 1998



Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed November 27, 2000.

The top five exporting countries did not include Canada for the 1993 to 1998 period. The top five were Australia, Turkey, Mexico, Syria and the United States, as shown in Figure 3-8. With the dramatic increase in Canadian chickpea acreage since 1998, it is projected that Canada for the year 2000 will be among the top five exporters.

Figure 3-8 Top Five Exporting Countries, Chickpeas, 1993 - 1998

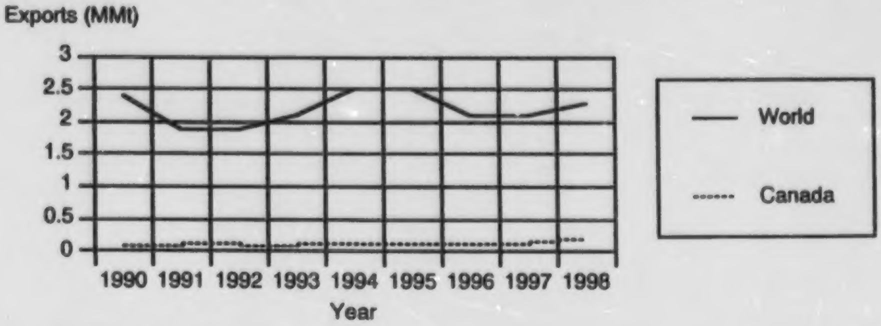


Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed December 6, 2000.

3.1.4 Beans

World dry bean exports ranged between 2.0 to 2.5 million tonnes between 1990 and 1998, with Canadian exports at less than 10% in 1998 as noted in Figure 3-9.

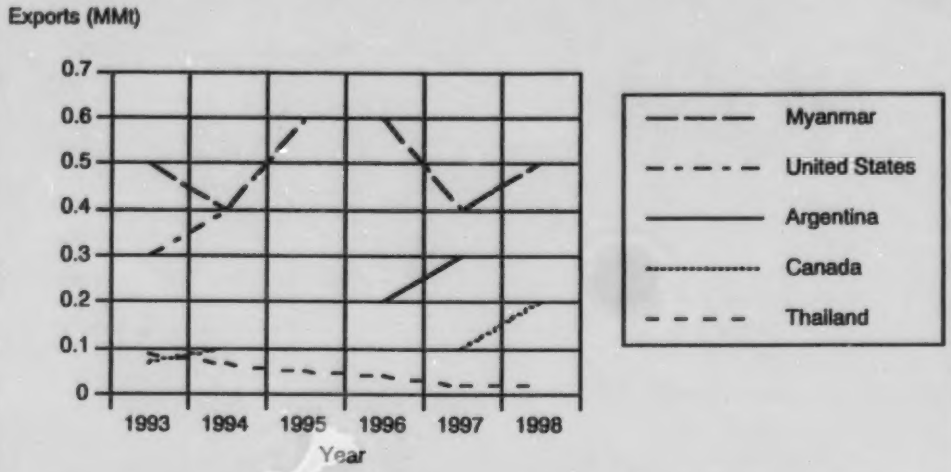
Figure 3-9 Bean Exports, Canada and the World, 1990 - 1998



Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed November 27, 2000.

Based on the 1993 to 1998 average, the top five dry bean-exporting nations were Myanmar, United States, Argentina, Canada and Thailand. Figure 3-10 shows that Canadian exports increased during the period while there has been a steady decline in exports from Thailand.

Figure 3-10 Top Five Exporting Countries, Beans, 1993 - 1998

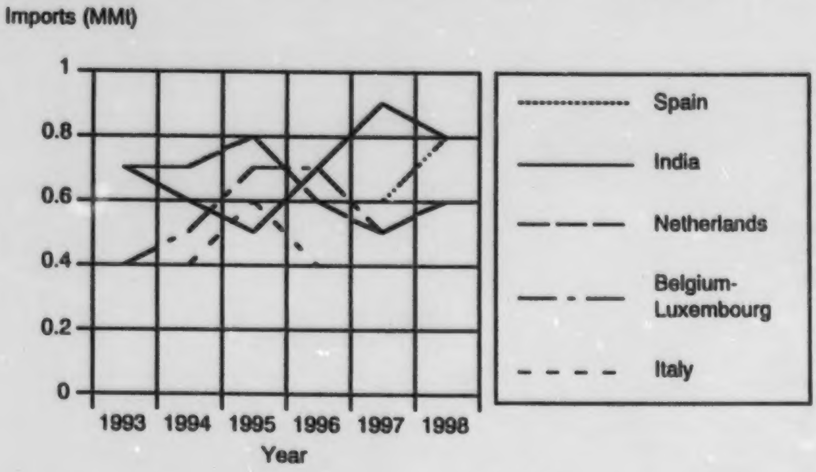


Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed December 6, 2000.

3.2 Global Imports

This section covers trends in imports by the top five importing countries for pulses in total; and for peas, lentils, chickpeas and beans. As with exports, the country ranking for imports was based on average imports during the 1993 to 1998 period. For all pulses combined the top five importing countries were Spain, India, Netherlands, Belgium-Luxembourg and Italy. Imports demonstrated considerable variability from year-to-year as shown by Figure 3-11.

Figure 3-11 – Top Five Importing Countries, Total Pulse Crops, 1993 - 2000

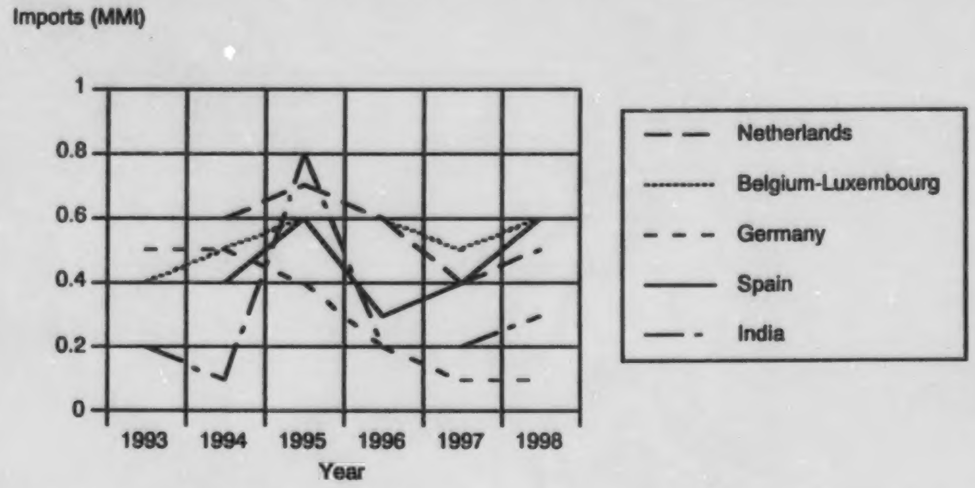


Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed December 7, 2000.

3.2.1 Peas

The top importing nations for peas were the EU countries of Netherlands, Belgium-Luxembourg, Germany and Spain followed by India. Figure 3-12 illustrates that imports were characterized by variability although there was a steady decline in imports by Germany during the period.

Figure 3-12 Top Five Importing Countries, Peas, 1993 - 2000

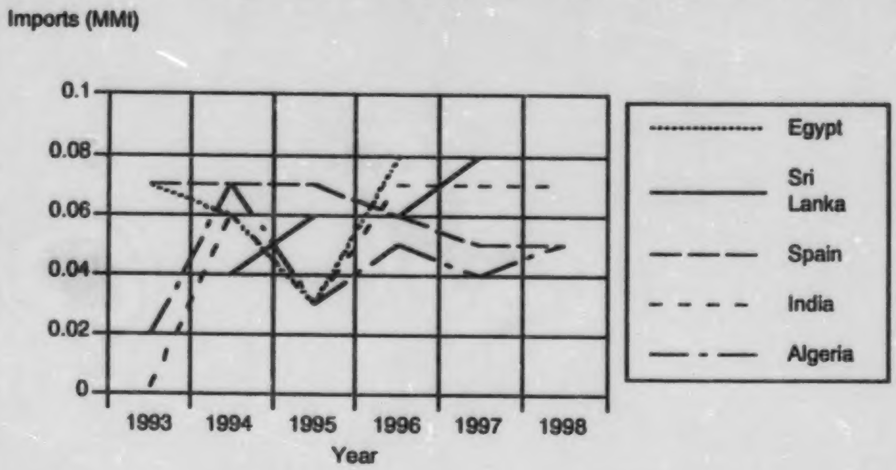


Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed December 7, 2000.

3.2.2 Lentils

The top five lentil importing countries were Egypt, Sri Lanka, Spain, India and Algeria. By 1998 India had moved into second place as the world's top lentil importing nation behind Egypt as noted in Figure 3-13.

Figure 3-13 Top Five Importing Countries, Lentils, 1993 - 2000

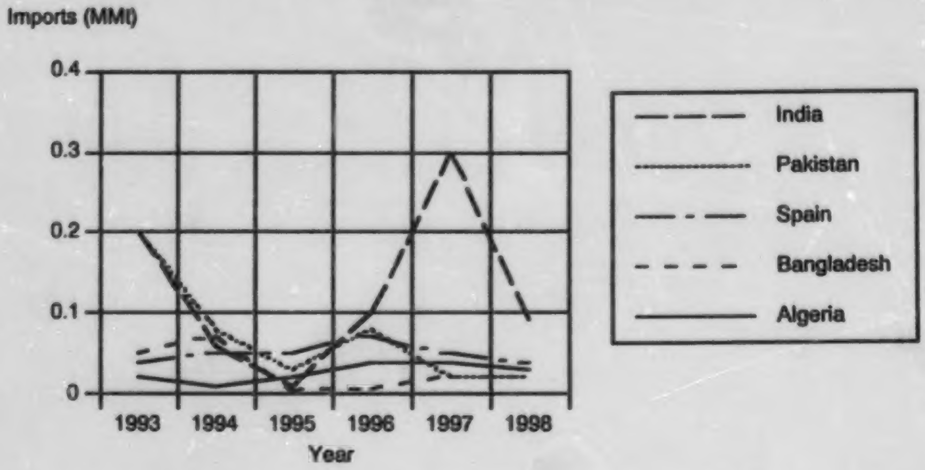


Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed December 7, 2000.

3.2.3 Chickpeas

Figure 3-14 illustrates that the top five importing countries for chickpeas are India, Pakistan, Spain, Bangladesh and Algeria. Imports by India experienced large variability during the 1993 to 1998 period while the imports of the other four countries remained relatively steady.

Figure 3-14 Top Five Importing Countries, Chickpeas, 1993 - 2000



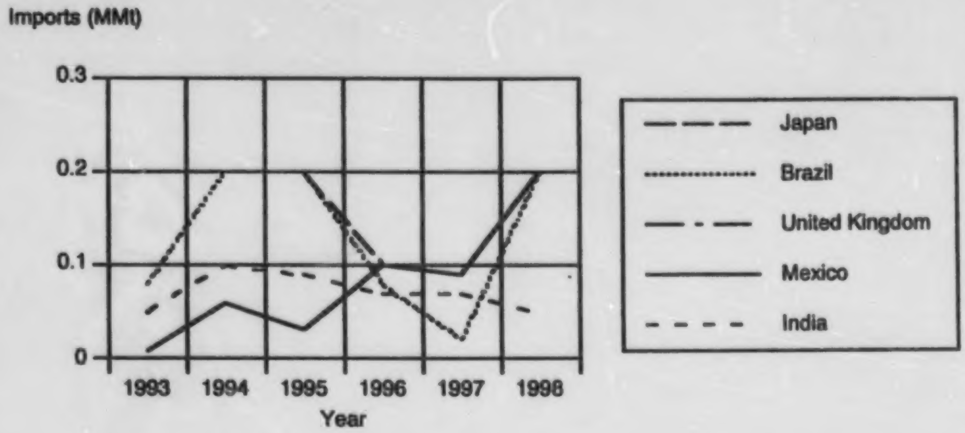
Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed December 7, 2000.

India is a price-sensitive importer, and their variable importation rates for pulse crops reflects that sensitivity.

3.2.4 Beans

The top five importing countries for dry beans as indicated by Figure 3-15 were Japan, Brazil, United Kingdom, Mexico and India. Imports by Mexico increased steadily while imports by the United Kingdom remained steady during the 1993 to 1998 period. Imports by the other three countries varied considerably throughout the period.

Figure 3-15: Top Five Importing Countries, Beans, 1993 - 2000

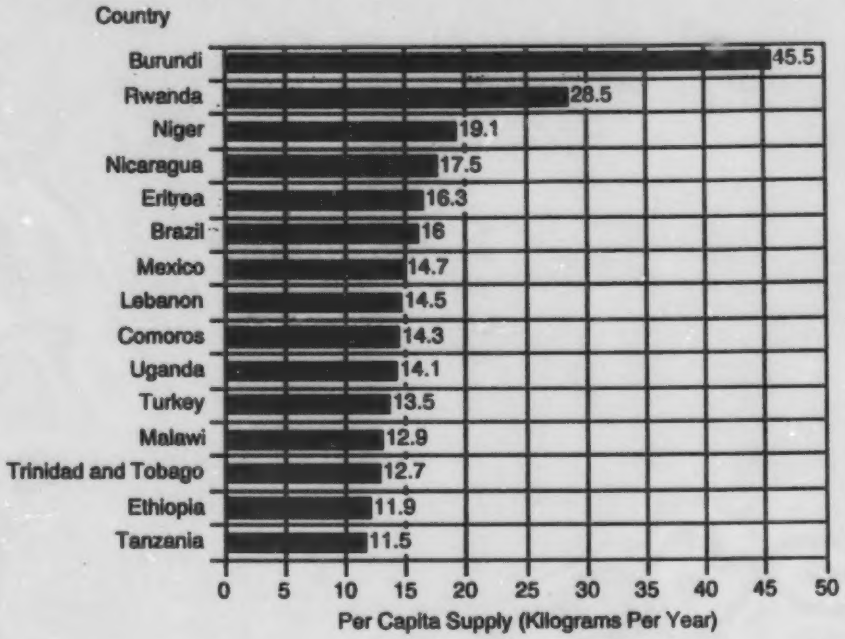


Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed December 7, 2000.

3.3 Consumption Patterns

This section reviews domestic consumption and utilization patterns for pulse crops. Figure 3-16 illustrates the estimated per capita consumption of pulse crops as measured by pulse crop supply on a net basis (i.e., production + imports – exports). The top fifteen countries in terms of per capita supply for 1998 are shown. It is evident that many of the poorer African countries rely heavily on pulse crops as nutrition sources. As expected, other areas with relatively high per capita consumption levels are countries in the Middle East, Mexico and Brazil.

Figure 3-16 Top Fifteen Countries, Per Capita Pulse Crop Supply, 1998



Data taken from the FAO Food Balance Sheets Database. Website accessed December 7, 2000.

Population growth projections for these areas, as well as for India and China, illustrated in Figure 3-17, indicate growing consumption and total demand for pulses.[21] A limiting factor for imports by these countries will be effective demand as per capita income levels tend to be low. It is evident from the countries on the top five importing lists that income levels will continue to be vital to effective demand and attainment of growing international trade in the future.

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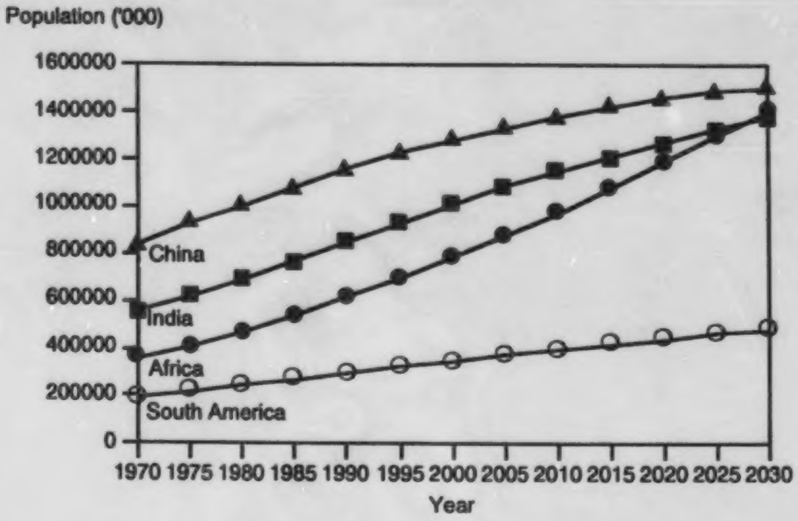
[21] Patterson, Garth. op. cit.

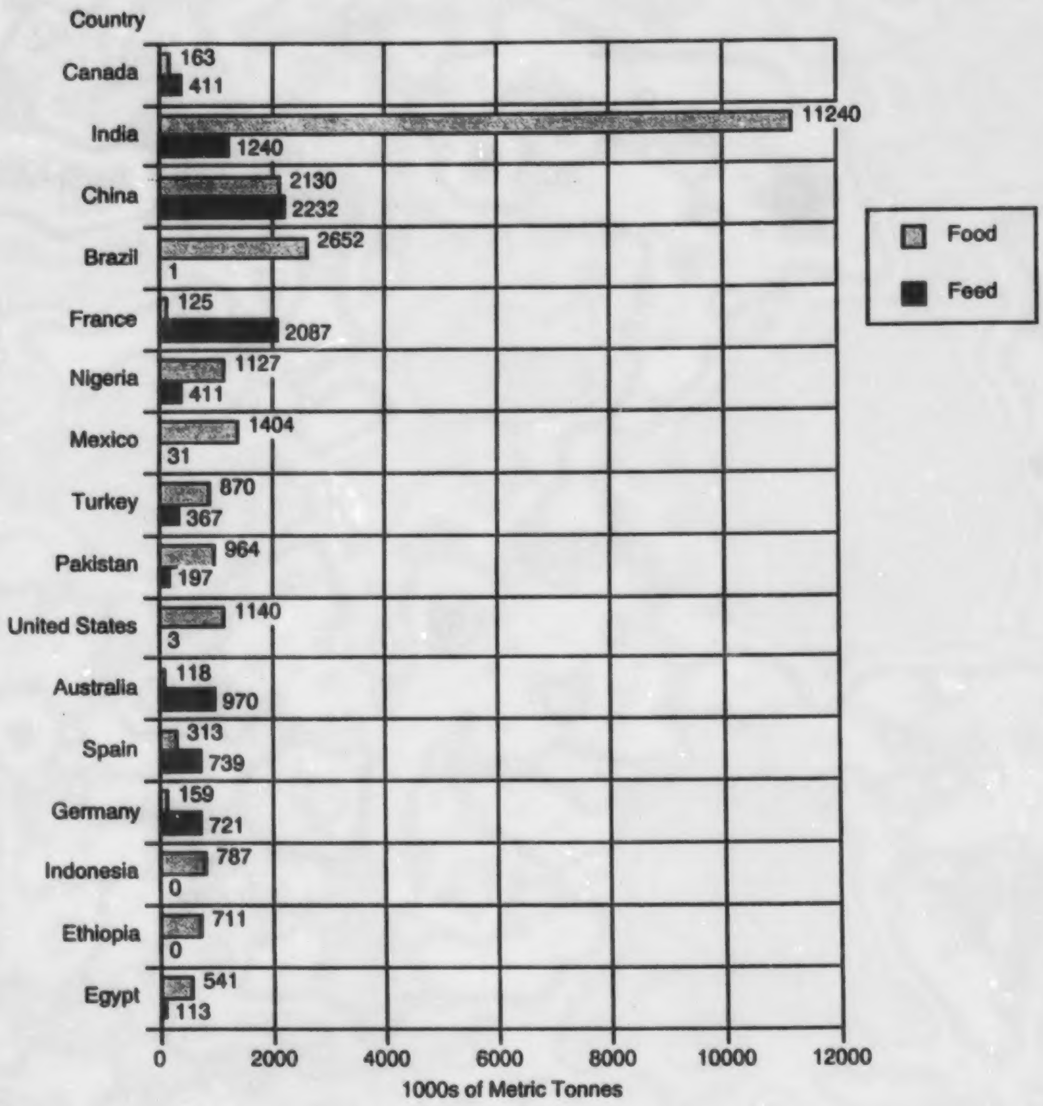
Figure 3-17 **Population Growth Projections for China, India, Africa, and South America**



Data taken from the FAO Agricultural Data, Population Database. Website accessed December 15, 2000.

Figure 3-18 illustrates total domestic utilization of pulses in 1998 by the top fifteen countries and Canada. India is by far the largest user of pulses followed by China, reflecting their large populations. Food use is the primary market in most countries such as India, Brazil, Mexico, Turkey, Pakistan, the United States and Egypt. However, feed use is also an important market in Canada, China, Australia, France and other EU Countries. Dry peas are an important source of protein in many livestock feed rations as a substitute for oilseeds meals. They can also potentially replace meat and bone meal, recently banned in EU livestock rations (estimated to be equivalent to 2 million tonnes of peas).

Figure 3-18 Domestic Utilization of Pulses, 1998



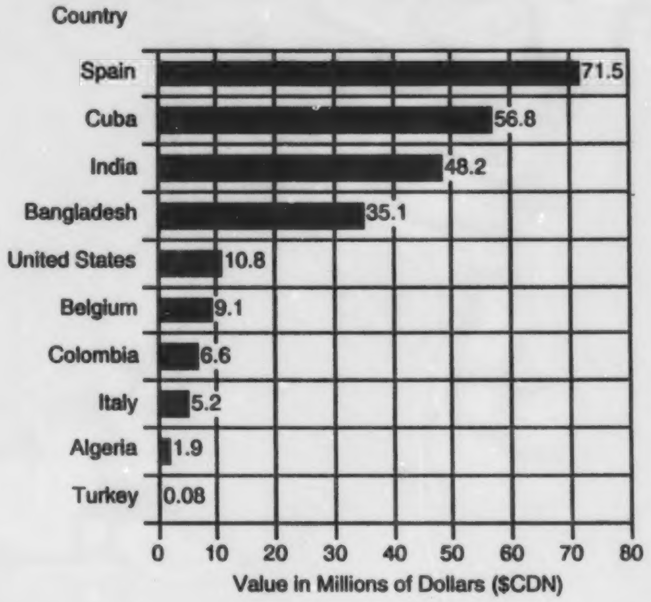
Canada ranks 20th overall in the world for domestic utilization of pulses.

Data taken from the FAO Food Balance Sheets Database. Website accessed December 11, 2000.

3.4 Canadian Pulse Crop Markets

This section contains information on the principal export markets for Canadian pulse crops based on the value of exports for 1999. Figure 3-19 indicates that the top five markets for Canadian peas are Spain, Cuba, India, Bangladesh and the United States.

Figure 3-19: Canadian Export Markets, Peas, 1999



Data from the Industry Canada Trade Data Online website, accessed December 12, 2000.

Figure 3-20 shows that the top five markets for Canadian lentils are Algeria, Turkey, Colombia, Spain and Italy.

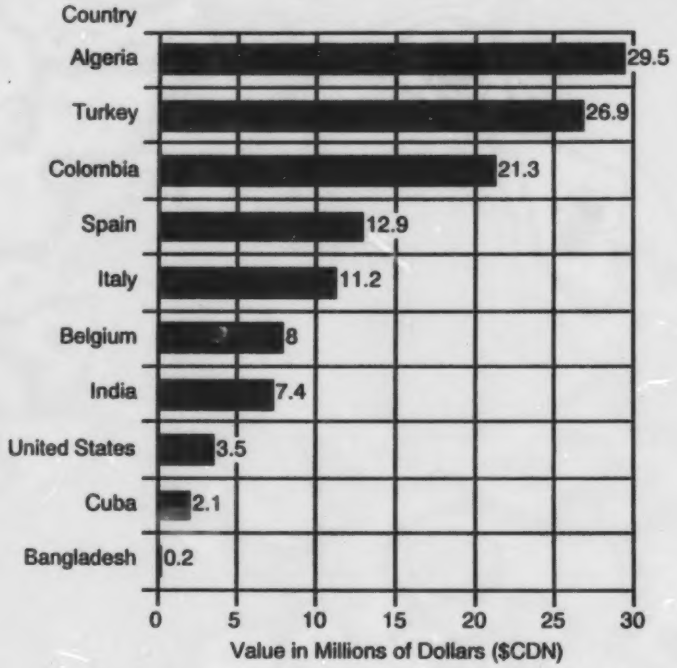
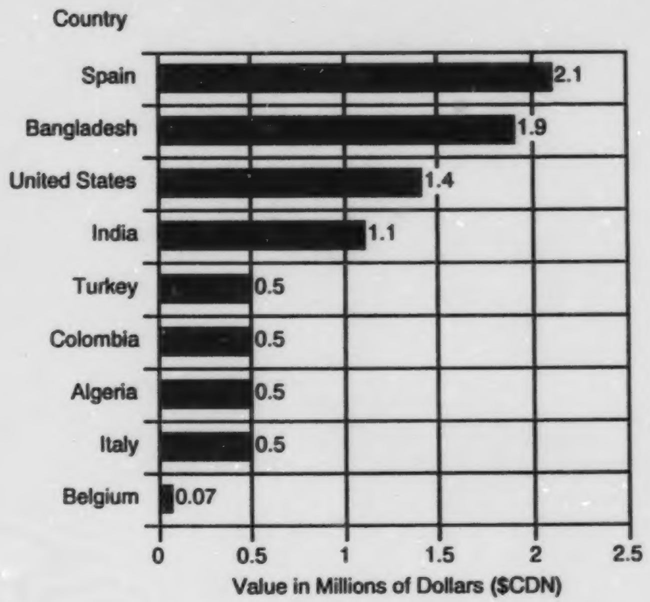


Figure 3-20 Canadian Export Markets, Lentils, 1999

Data from the Industry Canada Trade Data Online website, accessed December 12, 2000.

For emerging Canadian exports of chickpeas the top five markets as noted in Figure 3-21 are Spain, Bangladesh, United States, India and Turkey.

Figure 3-21 Canadian Export Markets, Chickpeas, 1999

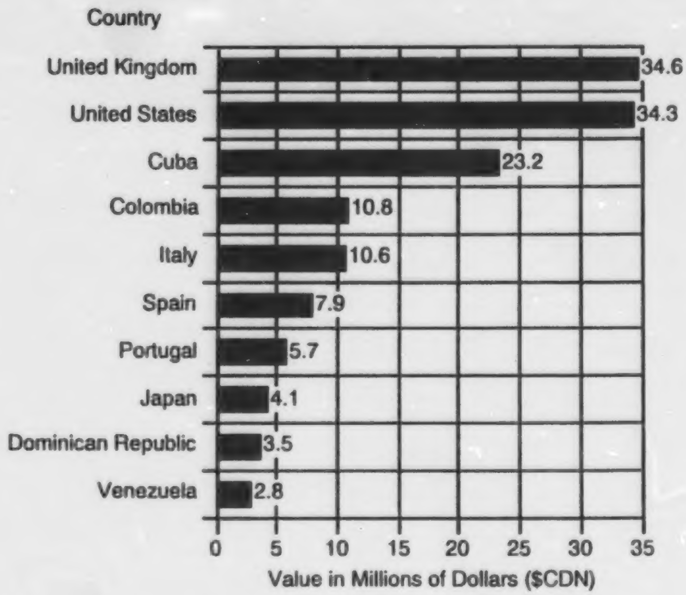


Data from the Industry Canada Trade Data Online website, accessed December 12, 2000.

Between 1995 and 1999, Cuba was also one of the top ten export markets for Canadian chickpeas. However, data were not available for the value of 1999 chickpea exports to Cuba.

The top five markets for Canadian beans are the United Kingdom, the United States, Cuba, Colombia and Italy as illustrated in Figure 3-22.

Figure 3-22 Canadian Export Markets, Beans, 1999



Data from the Industry Canada Trade Data Online website, accessed December 12, 2000.

Beans of the genus *Vigna mungo* and *Vigna radiata*, small red adzuki, kidney beans, white pea beans, broad beans, horse beans, vanilla beans and beans not otherwise specified are included here.

3.5 Future Pulse Market Trends and Opportunities

Future opportunities for pulse crops are found in the export markets around the world that have already begun to buy Saskatchewan pulses. The key opportunity is to build on the strength of Saskatchewan's emerging comparative advantage in pulse crops.

Many countries are shifting their domestic production patterns away from pulse crops and towards more profitable alternatives such as wheat, rice and horticultural crops. As these shifts occur, markets are opening for pulses that represent more profitable alternatives for Saskatchewan producers than traditional cereals and oilseed crops. At the same time, from agronomic and environmental perspectives, pulses fit extremely well into Saskatchewan crop rotations with cereal and oilseed crops.

The opportunity to expand Saskatchewan exports in the future depends on being able to build on our reputation of quality but also to improve that quality through better research on crop quality issues, nutrition and consumer preferences. There is an opportunity to improve grade standards to tighten dockage tolerances, for example to reduce the threat from unacceptably high canola dockage in dry pea shipments for livestock feed rations in EU countries.

There will clearly be growing opportunities for identity preserved shipments of products with quality characteristics unique to particular market preferences. For example, what represents quality in some markets may not represent quality in other markets (e.g., differences in color, size, shape, splits, etc.).

Pulse Canada's extensive market development and promotion program has already helped create an awareness of Canada's high quality pulses in most potential export markets. There is a need to build on the awareness created by this excellent work and to increase the frequency of Canada's presence in these markets on a year-round basis.

The Canadian and North American market represents a vital and stable future market for pulses. What is needed is greater domestic promotion on the nutritional and culinary values of pulses. There will be growing opportunities for packaged dry products, canned goods, soups and pre-cooked products. These products are already in consumer markets and consumption will grow as consumers become more aware of the protein value and other advantages of pulses relative to alternatives, as well as the ease of preparation that is possible under pre-cooking technologies.

The domestic livestock feed market represents a major growth channel for pulse crops, especially dry feed peas. The value of peas in hog rations has already been demonstrated and sales opportunities should grow as the hog industry expands. In growing this market it will help for the industry to ensure that producers deliver consistent quality and supply over time to minimize the need for changes in feed manufacturer's ration formulations.

Opportunities for further processing of pulse crops based on fractionation and ingredient utilization is still in the early stages of research, development and commercialization. It is known that the components of various pulse crops have unique characteristics that can be enhanced through their use in many products (e.g., industrial, pharmaceuticals, nutraceuticals, cosmetics, etc.). There needs to be a substantial increase in effort devoted to advancing knowledge and developing feasible value-added processing alternatives.

It is possible to link the extraction of components with desirable characteristics back to fundamental plant breeding strategies. Forward and backward innovation linkages in the research and development continuum need to be pursued to help realize the potential from research and development linkages related to component utilization and value added processing of pulses.

While there are many potential opportunities for the Saskatchewan pulse crop industry from the market perspective, there are unfortunately some significant and confounding threats. These threats could not only curtail future growth potentials but could undermine the emergence of pulses as a profitable alternative for farmers and rural businesses.

On the market side, the major threat comes from Australia that also has a significant comparative advantage in pulse crops as traditional importers shift their internal production patterns. Australia's focus on better quality and more reliable supply, as well as a reported massive investment in pulse crop research and development could quickly erode Canada's and Saskatchewan's advantages. As the leading pulse crop province in Canada, Saskatchewan has an opportunity and responsibility to lead in rapidly expanding pulse crop research and development to limit the impact of the Australian threat.

In addition to major under-funding of public pulse crop research, the pulse crop industry is also threatened by an unresponsive transportation and handling system. Labour disruptions, container shortages, and poor car allocation are examples reported during our interviews that undermine the industry's ability to consistently supply customers with products on time. These transportation problems must be solved or the industry will not achieve its potential because customers will go elsewhere (e.g., Australia, United States).

3.6 Implications for Future Research

There are numerous implications for future pulse crop research evident from market trends and opportunities. We found from our interviews that there should be a dramatic shift in emphasis and resources devoted to pulse crop research in Canada and in Saskatchewan in particular, as the leading province. Relative to the value of production, farm cash receipts and value added opportunities, the magnitude of pulse crop research for this growing industry is considered to be minimal.

There is strong support for substantial new spending on pulse crop research in the future, otherwise the industry won't be able to keep ahead of the problems and issues that need to be addressed. The benefits from additional research would be increased farm income and expanded rural economic activity.

There were remarkably similar views expressed by producers, marketers, researchers and government officials on the opportunities and future research needs. During our interviews, we found that pulse crop research needs cut across the spectrum of disciplines, the stages of processing and the continuum of research and development expertise.

One of the strengths of past research has been plant breeding. This area of expertise needs to be even further strengthened beyond what was accomplished under AFIF. However, other research disciplines such as plant pathology, genetics, biotechnology, agronomy and especially value added processing and component utilization also need to be significantly strengthened.

A key implication from the marketing perspective is the need for research to be more market-oriented than it already is and to focus on future needs and preferences, not on past production successes, as important as they are. Another vital implication, is that the transportation problem and associated equipment distribution issues require both research and urgent action.

4.0 GLOBAL AND CANADIAN PULSE CROP RESEARCH CAPABILITIES AND DIRECTIONS

Pulse crops are produced and consumed in many countries. Research facilities in support of production tend to be concentrated in the major producing countries. This section briefly identifies the main areas of existing research capabilities. It was not possible to determine the various priorities or magnitude of research expenditures for the various facilities. However, as a general rule increased yield is the primary focus of most breeding programs and supporting research.[22]

4.1 International Research Facilities

The main research conducted outside Canada on pulse crops occurs in the United States, France, Australia and in three international institutes. The USDA Agricultural Research Service conducts pulse crop research and breeding centered at Pullman, Washington.

Besides Canada, plant breeding has accelerated in the European Community and Australia over the past three decades.[23] European research tends to be conducted primarily on peas by private plant breeding companies. Australian public research and breeding is advancing quickly with an estimated annual investment of $25 million. The three international centers involved in pulse crop research are ICARDA (Syria), ICRISAT (India) and CIAT (Colombia). These institutes focus on all aspects of pulse crop breeding and research related to production in adjacent semi-arid areas.

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[22] McAndrew, Dave W. November, 2000. *Third Pulse Crop Research Workshop Proceedings*, Manitoba Pulse Growers Association, Winnipeg.

[23] Ibid.

4.2 Canadian Research Facilities

Canadian pulse crop research facilities are located primarily in Ontario, Manitoba, Saskatchewan and Alberta generally within or adjacent to the main producing areas. Several facilities are national in scope.

4.2.1 Ontario

Facilities operated by AAFC are located at Harrow and focus primarily on beans. Several private companies are also involved in bean research in Ontario.

4.2.2 Manitoba

Research facilities in Manitoba are operated by AAFC at Morden and Brandon with the principal focus on all aspects of bean and pea production. The University of Manitoba Plant Science Department is also involved in some pulse crop research. The Manitoba Department of Agriculture conducts applied research and extension on pulse crops.

4.2.3 Alberta

Alberta research facilities operated by AAFC are located at Lethbridge, Beaverlodge, and Lacombe. Lethbridge concentrates on bean research while Beaverlodge and Lacombe concentrate on pulse crop agronomy. Alberta Agriculture, Food and Rural Development operates the South and North Crop Diversification Centres at Brooks and Edmonton, respectively, with research, extension, and some breeding programs on pulse crops.

4.2.4 Canadian Organizations

4.2.4.1 Canadian Grain Commission, Grain Research Laboratory

Located in Winnipeg, the GRL has recently employed one research scientist to develop a research program on the quality aspects of pulse crops. This initiative responds to concerns from the industry that pulse quality and export grading standards need to be strengthened and be made more consistent internationally. This position will help advance Canada's role in discussions on international quality and grade standards.

4.2.4.2 Canadian International Grains Institute

The CIGI, located in Winnipeg, is responsible for organizing technical missions and training programs for users of Canadian grains and oilseeds. These services are offered as a means of extending knowledge and use of Canadian crops in export markets. More recently, it has also begun to offer services on special crops, including pulse crops. One of its initial roles is to collaborate with the CGC and other industry organizations on advancing the pulse crop quality initiative.

4.3 Saskatchewan Research Facilities

The principle organizations involved in pulse crop research in Saskatchewan are U of S Crop Development Centre, Agriculture and Agri-Food Canada (AAFC) and the Plant Biotechnology Institute, National Research Council (PBI). Several organizations such as Agricultural and Bioresource Engineering (AgBioEng), the Prairie Agricultural Machinery Institute (PAMI), Protein, Oil and Starch Pilot Plant (POS), Saskatchewan Food Centre (SFC) and other U of S departments also have roles in pulse crop research in Saskatchewan.

4.3.1 Crop Development Centre

The CDC is the focus of pulse crop research and breeding in Saskatchewan. Extensive programs are conducted on key production aspects related to lentils, peas and chickpeas. The bean program is currently expanding. CDC received a major boost in funding under AFIF with the establishment of the U of S Pulse Crop Chair and with funding of several breeding programs. With the exception of continued funding for the Chair, the AFIF funds will soon end.

4.3.2 Agriculture and Agri-Food Canada

Pulse crop research conducted by AAFC occurs at centres and research farms located at Saskatoon, Swift Current, Indian Head, Melfort and Scott. The principal focus of work is on pulse crop agronomy, field testing and demonstration. Field capacity for applied research and testing was recently enhanced with capital expenditures under AFIF. The Saskatoon Research Centre (SRCen) increased research on disease in chickpeas under an AFIF project. However, as this project ends, resources reportedly will be shifted to other non-pulse crop projects.

4.3.3 Plant Biotechnology Institute

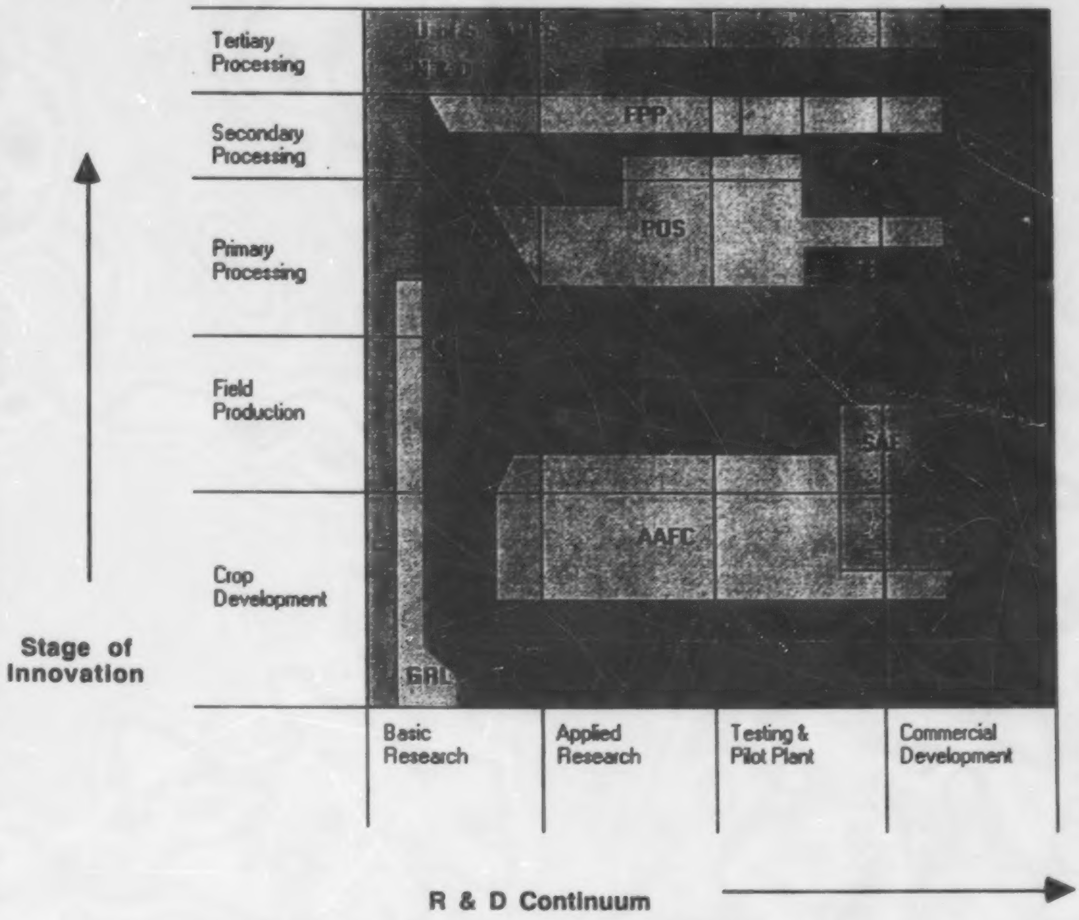
The focus of work at PBI is on genetics and the biotechnology aspects of plant science applicable to pulse crops. Two scientists work part of their time on pulse crops along with technical support staff. Activity levels vary in direct proportion with additional funding available from third-party sources.

4.3.4 Research Institution Relationships

With up to 16 publicly funded research organizations involved or potentially involved in pulse crop research in Saskatchewan there are many inter-agency relationships to manage. Figure 4-1 illustrates the breadth of these organizations. The x-axis of the figure represents the research and development continuum and the y-axis represents the stage of innovation or level of value-added processing. Based on knowledge of their respective roles and expertise in pulse crop research, each Saskatchewan organization is plotted along with the Canadian Grain Commission (CGC) and the Canadian International Grains Institute (CIGI). The result is a map of functional responsibilities and relationships.

For example, the University of Saskatchewan Agriculture and Bioresource Engineering (AgBio) conducts mainly basic research involving field production and primary processing. It also conducts some basic research involving secondary processing, and some applied research concerning primary processing and field production. By contrast, the Prairie Agricultural Machinery Institute (PAMI) is involved only in primary processing and field production, but conducts applied research and testing and pilot plant, as well as some basic research and commercial testing.

Figure 4-1 Functional Responsibilities of Pulse-Related Research Organizations in Saskatchewan


Tertiary Processing
Secondary Processing
Primary Processing
Field Production
Crop Development
Stage of Innovation
FPP
POS
AAFC
GRL
Basic Research
Applied Research
Testing & Pilot Plant
Commercial Development
R & D Continuum

Key: **U of S - AMFS N & D** = University of Saskatchewan Applied Microbiology and Food Science, Nutrition and Dietetics; **FC** = Saskatchewan Food Centre; **FPP** = Fermentation Pilot Plant; **AAFC** = Agriculture and Agri-Food Canada; **BPC** = Bio Processing Centre; **POS** = Protein, Oil and Starch Pilot Plant; **AgBio** = University of Saskatchewan Agricultural and Bioresource Engineering; **PFRC** = Prairie Feed Resource Centre; **PAMI** = Prairie Agricultural Machinery Institute; **SAF** = Saskatchewan Agriculture and Food; **CIGI** = Canadian International Grains Institute; **GRL** = Grain Research Laboratory, Canadian Grain Commission; **PBI** = Plant Biotechnology Institute, National Research Council, and **CDC** = Crop Development Centre, University of Saskatchewan.

Adapted from discussions with PAMI and Agricultural and Bioresource Engineering.

The figure illustrates that a complete spectrum of pulse crop research and development expertise currently exists within Saskatchewan institutions, located primarily in Saskatoon but with field linkages through AAFC and SAF. This spectrum of expertise is the basis for an international centre of excellence in pulse crop research.

Also illustrated by the figure is the reality that all institutions are critically linked to several others in conducting research responsibilities within their mandate areas. Additionally, each organization is linked with others in serving the needs of private sector clients. Management of these relationships with each other and with clients is vital to maximizing the efficiency and effectiveness of research and to realizing Saskatchewan's potential as a Canadian and international centre of excellence on pulse crop research and development.

4.4 Pulse Crop Research Funding in Saskatchewan

There are two principal methods for estimating research expenditures. The first method, or expenditure approach, requires a survey of institutions on estimated direct, indirect and overhead expenditures for pulse crops. This approach is complex because it is necessary for each institution to apportion a share of indirect and overhead costs to pulse crops based on a set of assumptions. The standards for apportionment may vary among institutions.

The second method, or source of funds approach, involves compiling data from various funding sources. This approach is useful for estimating incremental direct expenditures, but in some cases, it is still necessary to apportion expenditures from A-base resources. The second approach is used in this study.

Resources for pulse crop research in Saskatchewan are funded from four sources – provincial government, federal government, the Saskatchewan Pulse Growers checkoff and private companies. The amount of private company research in Saskatchewan on pulse crops was reported during the interviews to be still quite small, primarily because of the difficulty of capturing private gains from investment.

The main provincial government funding sources are the Strategic Research Program (SRP) with the U of S and the Proposal Based Program, both under the Agriculture Development Fund (ADF). An estimated 9% of SRP funds are allocated to pulse crop research, currently $369,000. Funds allocated under the proposal based ADF program currently average $662,887 annually. The SAF extension program is involved in applied research and demonstration in cooperation with the U of S and AAFC.

The key federal government funding sources are the A-base resources of AAFC and PBI devoted to pulse crop research. The main PBI expenditures are for human resources and technical support for basic biotechnology research.

AAFC expenditures are for human resources in support of the applied agronomic research on pulse crops conducted at the AAFC research stations and farms in Saskatchewan. Pulse crops are ineligible for MII in Saskatchewan because AAFC does not conduct any significant basic research in the province on pulse crops, other than limited work on disease control on chickpeas. Some funds for pulse crop research have been approved in the past from Canadian Adaptation and Rural Development in Saskatchewan (CARDS), although this is not expected to be a major source of future funds.

Based on interviews, the total value of federal A-base resources (PBI and AAFC combined) devoted to pulse crops in Saskatchewan is estimated to be $600,000 in a normal year and $800,000 during years that AFIF was effective as a result of resource leveraging (our estimates are subject to revision based on receipt of actual data). This level of funding involves a number of persons but is estimated to be the equivalent of a typical resource complement for 2 research scientists in a normal year and almost 3 during the AFIF years.

A major source of funds since 1996 for pulse crop research has been AFIF, a $91 million federal-provincial program, funded $64 million from the federal government and $27 million from the provincial. This funding source ends in 2002. Total funds allocated from AFIF for pulse crops was $5.46 million, $2.6 million of which was for the endowment of the U of S Pulse Crop Chair. The endowment, sourced solely from the provincial AFIF funds, will generate an estimated $175,000 annually in support of pulse crop breeding. The remaining $2.86 million was expended over approximately four years for an average of $714,500. These funds were sourced solely from the federal AFIF funds as the province put more than its proportional share of funds into the endowment.

The major growing source of pulse crop research funds in Saskatchewan is the Saskatchewan Pulse Growers producer check-off. The check-off is one-half of 1% of the value of sales. In 1999, $674,000 was allocated in support of pulse crop research (mostly in Saskatchewan) and the amount available to allocate to research will grow annually in direct proportion to pulse crop sales.

We have created an alternative scenario which projects a tripling of investment, over 1999 levels, in pulse research to a total of $10 million. This scenario has a cost-sharing ration of 40:30:30 amongst the provincial government, the federal government and producers. The ratio reflects the fact that the province of Saskatchewan, as the major pulse producing province in Canada, will receive the greatest gain through increased research. The federal government participates as a major partner in research and development. And, based on the present pulse growers levy, producers will be raising $6 million by the year 2005. Considering their current allocation to research, a total of $2 million would be available; however, our scenario anticipates that the growers could increase their research contribution to 50% of total levies, or $3 million.

Whatever cost-sharing ratio is adopted, the total $10 million funding target for 2005 represents slightly over three-quarters of 1% of projected farm cash receipts from pulses, only slightly higher than the proportion in 1999. This is a small percentage when compared to the investment that has been made in the canola industry.

Table 4-1 Saskatchewan Pulse Crop Research Funding

Funding Source	1995	1999	2002	2005	2005 (Sample Alternative)
$000					
SRP	369	369	369	369	3,200
ADF	225	663	663	663	600
AFIF	0	714	0	0	0
AFIF Chair	0	175	175	175	175
Federal Government Funds	600	800	600	600	3,000
Sub-total - Public	1,194	2,721	1,807	1,807	7,000
Pulse Growers	218	674	1,100	1,700	3,000
Total	1,412	3,395	2,907	3,507	10,000
Pulse Sales (in millions of dollars)	250	500	800	1,200	
Total Research (as % of Sales)	0.0056	0.0067	0.0036	0.0029	0.0083

Assumptions for Sample Alternative Scenario (2005):

- Funding target to be cost-shared 30% producers/industry, 30% federal government, and 40% provincial government.
- Increased provincial allocation through SRP.
- Increased federal A-base funding for AAFC and PBI with new funds totaling $3 million annually.
- Producer levy increased on the basis of increased provincial sales and share of levy funds allocated for research increased to 50%.

4.5 Comparative Research Initiatives

This section examines several recent studies that estimated rates of return to research expenditures in Canada for canola, wheat and pulses.[24,25,26] The estimated rates of return differ considerably among the three crops. The rate of return variations reflect striking differences in the structure of research, the size and direction of change in crop production and the magnitude of research in each crop.

Developing reliable rates of return estimates depends on assumptions used, the type of estimation methodology employed and availability of accurate research expenditure data. The studies examined use assumptions and methodologies that do not over-estimate rates of return.

The major limitation in the studies may be the accuracy of expenditure data. The primary data source is the Inventory of Canadian Agricultural Research (ICAR). Project resource data reported to ICAR are person-years. Expenditure estimates derived from person-years rely on assumptions about the value of direct, indirect and overhead costs apportioned to each project. There appears to be no validation of the accuracy of expenditure estimates derived in this manner although the data are the best publicly available.

4.5.1 Canola

Malla and Gray (1999) noted that canola research in Canada has evolved from a small publicly funded research program to one dominated by private sector firms. Private firms have been successful in capturing private benefits from canola research through, for example, development of herbicide tolerant varieties.

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[24] Malla, Stavroula and Richard Gray. 1999. *The Effectiveness of Research Funding in the Canola Industry*. Saskatoon: Department of Agricultural Economics, University of Saskatchewan. A final report prepared for Agricultural Development Fund, Saskatchewan Agriculture and Food.

[25] Gray, Richard and Stavroula Malla. 2000. *The Economics of CWRS Wheat Research in Western Canada 1961 – 1998*. Saskatoon: Department of Agricultural Economics, University of Saskatchewan. A report prepared for Agricultural Development Fund, Saskatchewan Agriculture and Food.

[26] Gray, Richard, Stavroula Malla and Shon Ferguson. *Agricultural Research Policy in Canada: Past Experience and Future Directions*. Saskatoon: Centre for Studies in Agriculture, Law and the Environment, University of Saskatchewan. A draft final report for Agricultural Development Fund, Saskatchewan Agriculture and Food.

Additionally, matching public funding under the Matching Investment Initiative (MII) of AAFC has leveraged new private investment into canola research in recent years. The MII is viewed by many as a highly successful program for fostering increased joint public/private investment in agricultural research.

Estimated expenditures on canola research in Canada have increased from less that $20 million annually in the early 1970's to $100 million in 1995 to $160 million in 1999. Measured as a proportion of Canadian farm cash receipts, canola research expenditures have increased from less than 1% to about 8% in 1995 to over 13% in 1999. Corresponding with the increase in research expenditures, Malla and Gray (1999) note that there has been a decline in the estimated internal rate of return from greater than 30% annually in the early 1970's to slightly over 5% in the late 1990's.

The authors report that this result is consistent with the adoption of technologies that permit private research firms to capture research returns. High rates of return attract increasing amounts of investment that eventually leads to returns falling to normal rates of return at which point investment normally ceases. Malla and Gray (1999) observe that the MII subsidy has contributed to over-investment in canola research since 1995 leading to a decline in canola rates of return below normal rates.

The foregoing result is consistent with expectations from economic principles. Thus, subsidies for private research should be shifted to support for public research where higher rates of return can be anticipated. The conclusion is consistent with the recommendations by Gray, et al (pending).

4.5.2 Wheat

As noted by Gray and Malla (2000) wheat research in Canada has remained largely in the public domain with little private sector investment, although a major source of wheat research funding for public research institutions is the Western Grains Research Foundation. There has been limited matching public funding under the MII because of the low level of private investment in wheat research and breeding.

Estimated expenditures on wheat research in Canada have remained steady, declining slightly in recent years to about $15 million annually. Measured as a proportion of Canadian farm cash receipts, wheat research expenditures are estimated to be less than one-third of 1% in 1995 increasing to almost one-half of 1% in 1999 as farm cash receipts from wheat decline. Gray and Malla (2000) note that the internal rate of return for wheat research has averaged 40% annually although there is high variability in annual rates of return reflecting the infrequency of economically significant research breakthroughs.

The return characteristics for wheat reflect the large area grown to wheat and the relatively low level of total investment in wheat research. The authors conclude there is under-investment in wheat research and room for increased public and producer investment. The rates of return for wheat research, however, may begin to show declines as wheat acreage continues to decline.

4.5.3 Pulse Crops

Gray et al (pending) have undertaken one of the first studies on the returns to pulse crop research in Canada. Pulse crop research is dominated by public sector research with significant support from producer check-off funds. Like wheat, pulse crops received limited MII funding reflecting the low level of private research investment.

Gray et al (pending) estimate research expenditures on pulse crops in Canada at about $15 million annually, declining slightly in recent years. It would appear that these expenditure estimates based on the ICAR database may include soybean research expenditures (based on our estimates of pulse crop research in Saskatchewan and factoring up for Canada, total annual pulse crop research spending may be in the order of $6 million annually). Consultations with various organizations confirm the difficulty of obtaining accurate estimates of pulse crop research expenditures. Further investigation is required to validate existing preliminary estimates on pulse crop research spending.

Estimates for Saskatchewan indicate that pulse crops research spending, as a proportion of farm cash receipts, totaled slightly more than one-half of 1% in 1995 and slightly more than that amount in 1999. Projections to 2002 and 2005 indicate a decline in research spending as a proportion of farm cash receipts, to slightly more than one-quarter of 1% in 2005. This situation reflects farm cash receipts from pulse crops growing more quickly than research spending under present research funding policy directions. This compares very poorly with annual canola research spending of more than 10% of farm cash receipts.

Gray et al (pending) note that estimates of rates of return for pulse crops are difficult to determine because of the relatively short production history. However, a preliminary estimate of the rate of return was developed for green and yellow peas, assuming 1999 crop acreage would continue into the future. This estimate was an internal rate of return of slightly more than 20% annually. The rates of return for pulse crops will tend to increase as yield and acreage increases, although Gray et al (pending) notes that there seems to be a long lag time between research expenditures and yield improvement.

In summary, current literature indicates that there would be significant economic gains from increased public, private and producer investment in pulse crop research. The industry is still in its early stages of development and appears to have major unrealized potential. Preliminary estimates of above normal rates of return (greater than 20% annually) can be expected to grow as crop yields, acreage and production increases.

5.0 PLANNED STRATEGIES FOR PULSE CROP RESEARCH IN SASKATCHEWAN

This chapter outlines the principal elements of a business plan and strategy for pulse crop research in Saskatchewan. The purpose of the plan is to help guide and focus the use of research resources on pulse crops in the future. The objective is to maximize the economic payback from public and private investments in pulse crop research in Saskatchewan and to ensure the greatest possible amount of cooperative and collaborative effort among researchers, the industry and funding agencies.

The proposed business plan for Saskatchewan pulse crop research can be used as a dynamic tool to guide future public and private investment in pulse crop research and development in the province. It is a plan with an initial time frame of five to ten years while providing a path for realizing the benefits over the next ten to twenty years of longer-term investments.

This section of the business plan examines the strengths and weaknesses of the pulse crop industry in Saskatchewan. It describes research needs and issues that must be addressed if the industry is to achieve and sustain its potential. Against this background context, critical research goals and priorities are defined that are reflective of discussions and interviews with a cross-section of industry participants and analysis of the data on global production and marketing trends. Finally, the plan articulates six strategic directions for enhancing the contribution of pulse crop research and development for future provincial economic growth and environmental sustainability.

5.1 Strengths and Weaknesses of the Saskatchewan Pulse Crop Industry

This section addresses the strengths and weaknesses of the Saskatchewan pulse crop industry and its supporting research infrastructure. Interviews with a cross section of pulse industry participants were the source of much of the data and information on industry strengths and weaknesses.

5.1.1 Industry Strengths

Strengths identified by the individuals interviewed did not differ materially among the various industry components (e.g., marketers, producers, researchers, etc.). Strengths rating high with many of the interviewees and in approximate order of frequency mentioned included the following:

1. Saskatchewan has strong existing capabilities in all facets of pulse crop research and research infrastructure (e.g., breeding, biotechnology, pathology, agronomics, seed, inoculants, inputs, farm machinery, processing and marketing, etc.).

2. Saskatchewan has a large semi-arid area with soils and climate well suited for expanded pulse crop production.

3. Producers have strong expertise in pulse crop production combined with a keen willingness to adopt new innovative agronomic and management practices as well as a motivation to diversify farming operations.

4. There are major environmental and conservation benefits from pulse crops including potential for substantial further reduction in summerfallow, nitrogen fixation, improvement of soil quality and enhancement of crop rotations with cereals and oilseeds.

5. Saskatchewan has a comparative advantage in pulse crop production based on a combination of factors such as soils, climate, yields, price competitiveness with alternative crops, quality, and an array of varieties suitable for numerous market segments and niches.

6. Producers have demonstrated strong leadership and commitment to research and market development through their involvement in several organizations (e.g., Saskatchewan Pulse Grower's

Association, Saskatchewan Pulse Crop Development Board, Pulse Canada and the Pulse Canada Research initiative).

7. Producer financial support for research through the industry check-off (i.e., 1/2 of 1% of the value of sales) is seen as having been a major boost to advancement of the pulse crop industry in Saskatchewan. Likewise, it is recognized that the provincial and federal governments have in the past and continue to financially support pulse crop research (SRP and ADF from the province, AFIF jointly and AAFC and PBI federally).

The momentum of strong growth in production combined with minimal trade barriers in most markets were also identified as closely related strengths and indicators of Saskatchewan's capacity to successfully supply markets in the future. The contribution of the industry to rural economic development and employment in Saskatchewan through value-added processing and diversification was seen as a very significant key result associated with expansion of pulse crop production in the province.

5.1.2 Industry Weaknesses

As with strengths, industry weaknesses identified by interview participants did not differ materially among the industry components (e.g., marketers, producers, researchers, etc.). Significant weaknesses noted are as follows, in approximate order of the frequency observed by interviewees:

1. Transportation problems are seen as a major on-going industry weakness contributing to the continuing perception of Canada as an unreliable suppler of pulse crops. The problem has several dimensions including:
   - labour disputes and handling disruptions at ports
   - high transportation costs,
   - long distances to ports,
   - unreliable and inequitable rail service,
   - continued bulk grain shipping mentality, and,
   - shortages of suitable shipping containers for bagged product.

2. Overall, research funding for Saskatchewan pulse crops is considered to be insufficient and unstable. The weakness related to research funding has several facets including:
    - funding level thought to be too low relative to research needed to support a rapidly growing industry,
    - funding too low relative to competitors (e.g., Australia, India),
    - wholly inadequate capital investment to upgrade and modernize pulse crop research infrastructure facilities to leading-edge world standards,
    - need to shift the balance towards more longer-term, stable operational funding away from the 'feast or famine' of unstable, short-term, project-focused funding,
    - need for funding organizations to rebalance research funding among various crops by shifting some funds from wheat and canola research to pulse crops research, more in line with future market opportunities, crop production research needs and potential economic development benefits,
    - insufficient funding for breeding program testing, quality and nutritional evaluation, post-harvest systems, fractionation and processing as well as market and transportation research, and,
    - need to tap external funding sources by marketing Saskatchewan's pulse crop research and breeding expertise across western Canada.
3. Production risks and agronomic limitations continue to be weaknesses. These risks include frost, cold weather, drought, disease, hail, and wind that can contribute to low and unstable yields and poor crop quality.
4. Weaknesses also relate to the need for greater industry attention to marketing factors such as the following:
    - need for higher, more consistent quality and grade standards (e.g., lower dockage tolerance in peas),
    - need for year-round market promotion and development in export markets,
    - need of greater focus on domestic market development, especially domestic livestock feed market for peas, and,
    - need for more market-oriented focus in research.

In summary, key industry weaknesses identified relate to transportation problems, inadequate pulse crop research funding, production and agronomic risks and insufficient attention to several marketing factors.

5.2 Research and Development Objectives

Based on analysis of the data and information compiled during this study, it is clear that the objectives for Saskatchewan pulse crop research and development should relate to provincial economic development and environmental sustainability. The proposed objectives for the business plan for pulse crop research are:

To enable researchers, within accepted scientific research standards and protocols to achieve the following:

- *to assist pulse crop producers to obtain competitive, market-based economic returns,*
- *to enhance the capacity of the pulse crop industry to realize its potential contribution to the economic well-being and diversification of the province, and*
- *to foster adoption of sound environmental and resource use practices.*

To date the pulse industry has demonstrated that it can uniquely contribute to both farm profitability and rural economic development and employment, not only through land use and cropping diversification but through primary value added processing in rural areas. It also has potential to expand processing to secondary and tertiary stages through component fractionation and processing.

The industry has also demonstrated its unique role in contributing to adoption of sound environmental and conservation practices. For example, incorporation of pulse crops into rotations along with cereals and oilseeds is contributing to reduced summerfallow acreage and reduced soil degradation from wind and water erosion and improved soil moisture management. Adoption of pulses in crop rotations is also contributing to improved disease and pest management. Further, pulse crops are contributing to enhanced soil quality, improved soil structure and desirable microbial populations to aid decomposition of organic matter. They are also contributing to reduced reliance on chemical based nitrogen fertilizers through nitrogen fixation effects.

It is anticipated that these results already being demonstrated by the pulse crop industry can be enhanced in the future through adoption of the foregoing business plan objectives.

5.3 Future Pulse Crop Research Priorities

Researchers were consulted on pulse crop research priorities over the next five to ten years. To assist industry to grow and prosper, researchers state that research and development should focus on the following priority issues and topics:

1. Incorporate molecular marker-assisted selection technology in breeding programs;
2. Incorporate double haploid breeding technology for pulses in tandem with marker-assisted selection strategies;
3. Incorporate improved pathology screening technology for major disease of concern in pulse crop breeding;
4. Implement transgenic tools for pulse crop breeding in combination with marker-assisted selection technology;
5. Implement a variety of agronomic selection technology for pulse crop breeding systems;
6. Implement rapid assessment technology for the major quality characteristics of interest in pulse crop improvement including culinary, processing, chemical and hedonic traits;
7. Integrate interspecific hybridization technology for use in genetic improvement of pulse crops;
8. Implement breeding systems that will allow pulse crop breeding to compete with oilseed and cereal breeding systems, including refinement of adaptation to specific production zones in Saskatchewan and across western Canada;
9. Commercialize prototype products and processes applicable to pulse crops thereby developing new uses and markets for Saskatchewan pulses;
10. Commercialize pulse varieties and pulse constituents for enhanced animal feed performance.

5.4 Strategic Research Directions

To address future pulse crop research priorities, it is proposed that a six-part integrated, strategic action plan be adopted by the pulse crop industry, the participating research institutions and the governments of Saskatchewan and Canada. The following plan maps out strategic directions for research partnerships, funding levels, targeting of funds, capital investments and human resource enhancement.

Strategic Direction 1 – Strengthen partnership relationships among the public institutions conducting various facets of pulse crop research in Saskatchewan.

Rationale

About 27 Canadian organizations or divisions of organizations have been identified as currently or potentially involved in conducting research on various aspects of pulse crops. About 16 of these organizations are located in Saskatchewan, many in Saskatoon. There are numerous examples of collaboration and cooperation among these institutions on pulse crop research projects[27] as well as many informal relationships and avenues of communication.[28]

Proposal-based programs, such as ADF and AFIF, drive competition among research organizations, which, in turn, tends to impede efforts to maintain cooperative relationships. One result of such behavior is often unclear understanding among research colleagues about the future research plans and directions of their respective organizations. A further result is apparent overlap and confusion when organizations submit competing research funding applications. This phenomenon was encountered during preparation of material for the initial phase of this project.

A strategy of strengthened research partnerships for pulse crops in Saskatchewan requires action by funding agencies and research institutions.

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[27] McAndrew, op. cit.

[28] Mahon, personal communication.

Funding organizations should consider curtailing practices that drive competition for short-term project-based research funding within the province. The Saskatchewan research community is too small and the size of available funding resources too limited to warrant the loss of human resource time needed for preparation and review of competing project applications. Instead, funding agencies should consider redirecting a larger proportion of funding towards longer-term collaborative initiatives involving research institutions with complementary skills.

For SAF, for example, this approach would mean shifting more resources within ADF towards SRP type initiatives on pulse crops. The same principle applied to AAFC would mean shifting some resources from MII towards more strategic, longer-term research initiatives. The same concept can also be applied to research funding by the pulse crop industry.

Strengthening partnerships requires that research institutions involved with pulse crops strive to know and understand their respective capacities and future plans. More importantly, it means that institutions should present collaborative research proposals to funding organizations that build on their respective strengths. It means being able to clearly articulate how organizations will be working together and how responsibilities will be shared among researchers. No one Saskatchewan institution should expect to be solely funded for pulse crop research in the province.

A pillar to recognition as a world class centre in pulse crop research and development is integration and coordination of skills and capacities of all institutions involved in pulse crop research. With commitment and persistence, strategic infrastructure investments, and clear incentives by governments for cooperation, Saskatchewan research institutions working together can become, as one, a world class 'virtual institution' for pulse crop research and innovation.

Implementation of this strategic direction involves 'changing the rules' for funding and implementing pulse crop research and development in Saskatchewan. It means moving more towards a collaborative/cooperative-funding model and away from a competitive funding model.

This approach means that various departments within the U of S, including the CDC will need to work more closely together in the future. It means that U of S departments will also need to work more closely with other research organizations such as PBI, AAFC, POS, FC, BPC, PAMI and FPP on pulse crops. Finally, it means that all of these institutions together will be a key pillar of the Pulse Canada Research Initiative. Collaboration and cooperation should become the norm.

Strategic Direction 2 – Triple funds allocated annually for pulse crop research by public and industry funding agencies over the next three to five years.

Rationale

Funding for pulse crop research in Saskatchewan was estimated to be about $3.4 million in 1999. This funding level was slightly higher than earlier years as a result of AFIF $2.6 million endowment funding of the U of S, CDC Pulse Crop Chair and several proponent-based projects, as well as increased producer check-off funds linked to increased pulse crop production.

The AFIF endowment will generate projected earnings of $175,000 annually for pulse crop research in 2000-01 but earnings will vary annually in the future depending upon revenues from the U of S long-term investment pool. AFIF project funds for pulses totaling about $2.9 million will cease in 2002, except where project extensions have been authorized. In several instances, A-base resources levered temporarily into pulse crop research by AFIF may be re-allocated to other crops.

Overall, projections indicate that pulse crop research funds in Saskatchewan will decline by 2002 to about $2.9 million. As there is currently no linkage between public and private funding for pulse crops, a decline in AFIF funds for pulse crop research will not be fully offset by an increase in private funds from the producer check-off. Without a change in public funding policy for pulse crops, growth in pulse crop research funds will grow in the longer term only in proportion to growth in pulse crop production and sales, reaching an estimated $3.5 million in 2005.

Significant research needs were identified during industry interviews. Critical needs relate to yield, disease, weed control, hardiness, maturity and quality. These limitations need to be addressed as the industry grows and pushes the geographic and agronomic boundaries of production. As the industry expands, the risk of a disaster from a widespread disease breakout or weed infestation also grows. The economic costs and consequences of a crop failure in pulse crops would be immense as the industry grows and producers depend increasingly on pulse crops for a significant portion of their net farm income. Research and breeding are essential tools for reducing and managing these production risks and limitations.

Preliminary research results[29] indicate potentially high economic returns to additional spending on pulse crop research. Higher rates of return can be expected for pulses than for canola research, for example, where it would appear that unusually high research funding in recent years has lead to diminishing returns. From an economic perspective, it is sensible to consider shifting public funds towards those research areas, such as pulse crops where it is evident there may be higher rates of economic return as the industry expands.

Interviews with industry participants indicate that Australia has earmarked significant new funds annually to support growth in their pulse industry to potentially become a major export competitor to Canada. Other countries such as India also are reported to contribute significant funds to pulse crop research. It was impossible to verify funding levels of competitor countries during this project. However it was evident during interviews that industry participants are seriously concerned that Canada's future global competitiveness in pulse crops will be eroded without a significant increase in Canadian pulse crop research.

In summary, a goal of tripling annual spending on pulse crop research in Saskatchewan over three to five years would mean an increase in total public and private spending from about $3.4 million annually 1999 to an estimated $10 million annually. This is a reasonable research funding target if pulse crops are to achieve and sustain Saskatchewan's production potential. Federal and provincial governments in cooperation with Saskatchewan pulse growers and other industry participants will need to determine sources of funds and cost sharing arrangements. Based on economic analysis,[30] the rate of return on this investment is projected to average in excess of 20% per year.

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[29] Gray 2000, op. cit.

[30] Ibid.

Strategic Direction 3 – Target future funds allocated for pulse crop research to resolving problems that impede advancement and growth of the pulse crop industry in Saskatchewan.

Rationale

One of the reasons for success to date in the Saskatchewan pulse crop industry is that research and breeding has focused on adapting and modifying cultivars to Saskatchewan's soil and semi-arid climatic conditions. This approach worked successfully first for lentils in the 1970's, for peas during the 1980's and then for chickpeas during the 1990's. The next challenge is beans. This approach to research and adaptation has been forward looking and has been a key factor in introduction and expansion of pulse crop acreage.

The next phase of pulse crop research will need to focus on refinement and diversification of crop characteristics to meet a range of market needs and preferences. Past experience confirms the need to continually focus research on problems and issues that reflect market needs and/or impede continued production growth.

Pulse crop researchers from various institutions and provincial grower associations in Saskatchewan, Manitoba and Alberta have organized the biannual Pulse Crop Research Workshop as a forum for sharing information on research directions and projects.[31] This is an important mechanism for helping to keep research targeted and coordinated and for maximizing the effectiveness of research investments.

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[31] McAndrew, op. cit.

Strategic Direction 4 – Invest public and industry funds in infrastructure to upgrade and modernize Saskatchewan pulse crop research facilities equipment to world class standards.

Rationale

During the course of this project, many persons interviewed indicated that Saskatchewan has a very strong pulse crop research program involving facilities and human resources from a number of organizations. It was also noted that AFIF cooperated with the pulse growers and the CDC in establishment of specialized seed cleaning infrastructure to facilitate the preparation of breeder seed stock for dissemination to seed growers.

Several key institutions have recently completed upgrades and modernization of facilities that may help strengthen future pulse crop research. These institutions include PBI, AAFC and the Applied Microbiology and Food Science Department of the U of S. At the same time, additional improvements in infrastructure facilities would be required as part of an expanded integrated approach to pulse crop research.

Interviews indicate that a significant gap exists in facilities for pulse crop breeding and testing. The facilities used by CDC were built in 1972. Space is now very limited in relation to growth of the pulse crop research program. Additionally, facilities and equipment are in urgent need of modernization and upgrading.

Cost estimates for a world class centre of excellence in pulse crop research and breeding were prepared in cooperation with the U of S and other key institutions earlier in this project. Estimates were in the order of $20 million for needed facilities and equipment. If funds were borrowed for this infrastructure, repayment could be accommodated over a reasonable time period within the scope of the proposed tripling of pulse crop research funding over the next three to five years. The exact details of financing arrangements would need to be negotiated with the institutions involved. Leasing of suitable facilities (e.g., Innovation Place) might also be an option.

Negotiations would also need to ensure that the incremental infrastructure would be linked closely with existing infrastructure. This approach could facilitate creation of an international research centre of excellence based on the totality of capital infrastructure relevant to pulse crops from several institutions.

Strategic Direction 5 - Direct public and industry funds towards resources to enhance retention, recruitment, training and retraining of additional scientific and technical human resources for pulse crop research.

Rationale

The core of past successful pulse crop research and development in Saskatchewan has been the existence of a small, dedicated group of scientific and technical human resources. Future success will also depend on having the right human resources working on the right research problems and issues at the right time. Flexibility, adaptability and innovation have been key characteristics of human resources involved in past research and will be vital to the success of future research.

As the industry grows and research problems multiply, additional human resources will be required. Strengthened expertise will be needed in plant breeding, plant pathology, genetics, biotechnology, microbiology, nutrition, food science, agronomy, engineering and economics (transportation and marketing). It is anticipated that a doubling in human resources devoted to pulse crop research in Saskatchewan will be needed over the next three to five years. This doubling would be within the scope of a tripling of total research expenditures.

Funding for the human resources would come from the projected increase in funds for future pulse crop research. The exact details of future human resource requirements and associated funding implications will need to be addressed by the CDC and other institutions expected to be involved in future research. Funding for human resources and associated operational expenditures will need to be balanced with funding required for capital infrastructure.

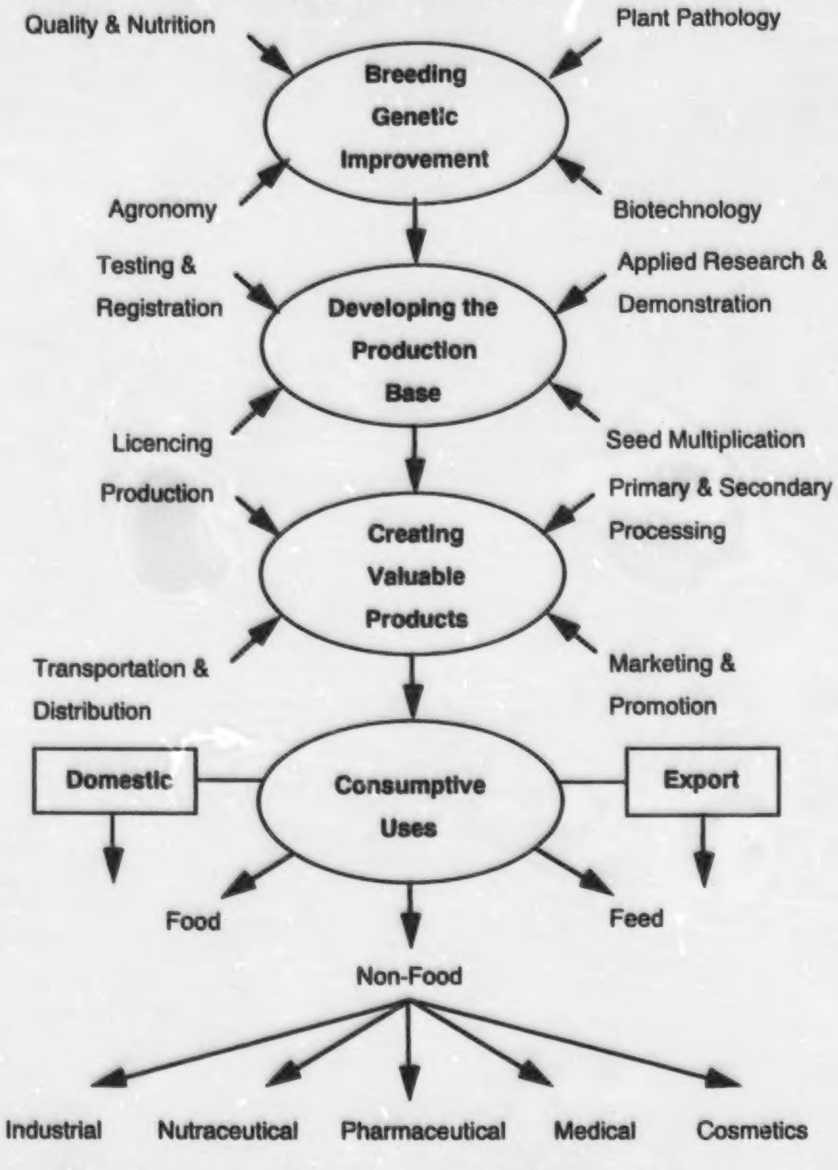
Strategic Direction 6 – Ensure that pulse resources encompass all aspects of the value chain from breeding and genetic improvement activities to human and animal consumptive uses.

Rationale

Research related to the pulse industry is needed at all levels of the value chain. Of course, research must support advancements in genetics, breeding and agronomy, but issues of transportation, marketing and value-adding are equally as important.

Figure 5-1 illustrates a value chain for Saskatchewan pulse crops moving from genetic improvement through to the creation of valuable products for consumptive uses as food, feed and non-food products in various domestic and export markets. The value chain concept helps visualize where and how the focus of research efforts may evolve over time to facilitate the application of science to the production and use of plant material.

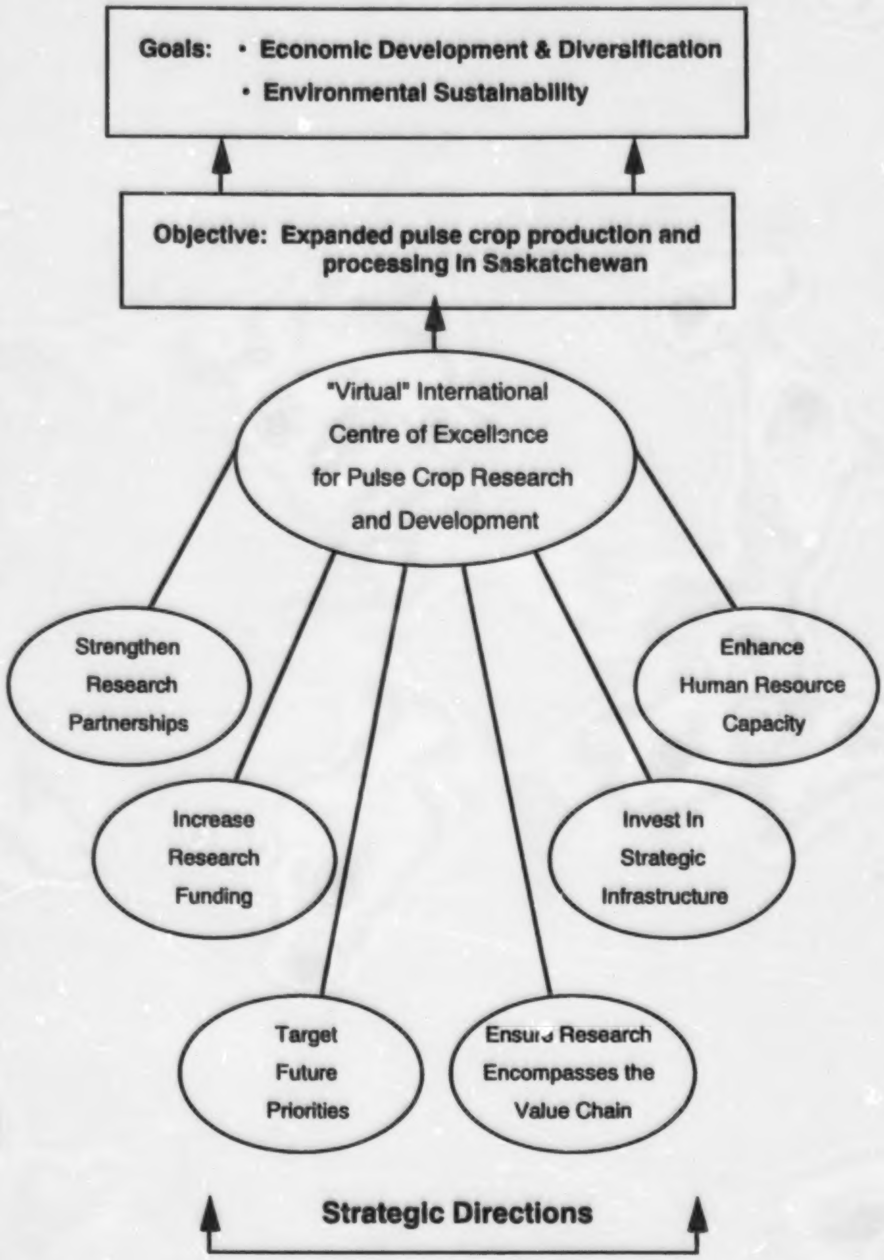
Figure 5-1 Saskatchewan Pulse Crop Value Chain


Quality & Nutrition
Plant Pathology
Breeding Genetic Improvement
Agronomy
Biotechnology
Testing & Registration
Applied Research & Demonstration
Developing the Production Base
Licencing
Seed Multiplication
Production
Primary & Secondary Processing
Creating Valuable Products
Transportation & Distribution
Marketing & Promotion
Domestic
Consumptive Uses
Export
Food
Feed
Non-Food
Industrial
Nutraceutical
Pharmaceutical
Medical
Cosmetics

Evolved from discussions with Bert Vandenberg, CDC, U of S, Saskatoon, November 2000.

The elements of the business plan and strategy for pulse crop research are illustrated in Figure 5-2.

Figure 5-2 Pulse Crop Business Plan and Strategy Framework


Goals: • Economic Development & Diversification
• Environmental Sustainability
Objective: Expanded pulse crop production and processing in Saskatchewan
"Virtual" International Centre of Excellence for Pulse Crop Research and Development
Strengthen Research Partnerships
Enhance Human Resource Capacity
Increase Research Funding
Invest in Strategic Infrastructure
Target Future Priorities
Ensure Research Encompasses the Value Chain
Strategic Directions

6.0 REFERENCES

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APPENDICES

Appendix A - Pulse Production and Trade Data

Table 1-A Top Pulse Producing Countries

All data in Mt

Total Pulse Production, Top Five Countries

	India	China	Brazil	Canada	France
1995	14,096,800	4,383,976	2,966,327	2,102,300	2,770,342
1996	12,309.700	4,692,174	2,844,140	1,699,500	2,629,096
1997	14,243,700	4,042,710	2,863,556	2,325,300	3,121,076
1998	13,070,000	4,869,397	2,225,434	3,062,600	3,309,788
1999	16,095,000	5,050,197	2,842,850	3,457,400	2,714,972
2000	16,095,000	5,566,697	3,125,440	4,142,400	2,121,500

Pea Production, Top Five Countries

	France	Russian Federation	Ukraine	Canada	China
1995	2,701,000	1,212,100	1,376,000	1,454,700	1,000,000
1996	2,562,000	1,322,920	985,000	1,173,000	1,207,200
1997	3,052,000	1,195,820	903,000	1,762,200	1,000,000
1998	3,224,728	660,140	652,000	2,337,000	1,207,200
1999	2,617,000	598,070	498,000	2,251,900	1,270,000
2000	2,026,000	700,000	639,000	2,936,900	1,300,000

Lentil Production, Top Five Countries

	India	Turkey	Canada	Bangladesh	Nepal
1995	783,800	665,000	432,000	167,945	99,776
1996	713,700	645,000	402,500	169,945	117,720
1997	882,700	515,000	378,700	170,505	124,420
1998	850,000	586,000	479,700	162,700	113,520
1999	900,000	586,000	723,800	165,315	132,290
2000	900,000	586,000	723,800	165,315	135,000

Table 1-A Top Pulse Producing Countries, continued

Chickpea Production, Top Five Countries

	India	Turkey	Pakistan	Iran, Islamic Republic of	Australia
1995	6,435,500	730,000	558,500	354,934	286,909
1996	4,979,000	732,000	679,600	350,133	267,721
1997	5,566,000	720,000	594,400	266,975	199,840
1998	6,127,000	600,000	767,100	248,632	160,000
1999	6,700,000	600,000	697,900	171,036	187,000
2000	6,700,000	600,000	664,500	200,000	198,000

Bean Production, Top Five Countries

	India	Brazil	China	United States	Mexico
1995	3,400,000	2,946,267	1,410,976	1,392,000	1,270,915
1996	3,000,000	2,822,340	1,543,174	1,266,000	1,349,098
1997	3,600,000	2,840,243	1,312,210	1,332,000	965,056
1998	3,000,000	2,199,934	1,576,697	1,379,700	1,260,658
1999	4,550,000	2,817,350	1,668,197	1,507,300	1,080,631
2000	4,550,000	3,103,440	1,910.,197	1,168,640	1,157,769

Data taken from the FAO Crops Primary, Agricultural Production Database. Website accessed November 27, 2000.

Table 2-A Pulse Production: World, Canada, and Saskatchewan

All data in Mt

Total Production

	World	Canada	Saskatchewan
1990	58,412,547	586,600	281,300
1991	54,362,268	895,900	445,100
1992	50,809,104	988,200	500,800
1993	55,088,594	1,459,700	901,100
1994	56,229,969	2,074,100	1,279,900
1995	54,873,923	2,102,300	1,250,100
1996	53,513,829	1,699,500	1,103,200
1997	55,243,701	2,325,300	1,540,900
1998	56,123,492	3,062,600	2,135,800
1999	58,667,902	3,457,400	2,481,100
2000	59,631,[illegible]	4,142,400	3,054,300

Pea Production

	World	Canada	Saskatchewan
1990	16,693,036	264,000	103,400
1991	12,374,746	409,700	160,600
1992	13,430,413	504,800	244,900
1993	14,896,530	970,200	585,100
1994	14,418,074	1,441,000	898,100
1995	11,485,509	1,454,700	868,200
1996	10,840,834	1,173,000	729,400
1997	12,040,731	1,762,200	1,158,100
1998	12,168,335	2,337,000	1,613,800
1999	11,704,701	2,251,900	1,623,400
2000	11,704,701	2,936,900	2,091,500

Table 2-A Pulse Production: World, Canada, and Saskatchewan, continued

Lentil Production

	World	Canada	Saskatchewan
1990	2,562,988	213,200	172,400
1991	2,655,630	342,800	272,200
1992	2,566,376	349,000	254,000
1993	2,756,615	348,700	315,200
1994	2,785,449	450,400	381,000
1995	2,843,420	432,000	381,900
1996	2,772,619	402,500	373,800
1997	2,679,717	378,700	365,200
1998	2,898,751	479,700	465,900
1999	3,146,677	723,800	702,900
2000	3,226,260	723,800	962,800

Chickpea Production

	World	Canada	Saskatchewan
1990	6,787,963	0	n/a
1991	8,113,633	0	n/a
1992	6,647,497	0	n/a
1993	6,777,090	0	n/a
1994	7,094,319	0	n/a
1995	9,108,065	0	n/a
1996	8,006,206	0	n/a
1997	8,253,612	14,500	14,500
1998	8,783,754	50,900	50,900
1999	9,336,094	187,200	187,200
2000	9,392,899	187,200	n/a

Table 2-A Pulse Production: World, Canada, and Saskatchewan, continued

Bean Production

	World	Canada	Saskatchewan
1990	17,029,542	104,800	n/a
1991	16,329,962	124,700	n/a
1992	15,317,443	123,200	n/a
1993	15,516,384	130,800	n/a
1994	17,165,536	170,700	n/a
1995	17,142,777	203,100	n/a
1996	16,824,586	112,500	n/a
1997	17,000,992	160,400	3,100
1998	16,777,109	185,000	4,100
1999	19,139,022	284,500	9,500
2000	19,607,771	284,500	n/a

World and Canada statistics from the FAO Crops Primary, Agricultural Production Database. Website accessed November 27, 2000.

Saskatchewan statistics provided by Saskatchewan Agriculture and Food.

Table 3-A Farm Cash Receipts, Saskatchewan (Thousands of Dollars)

	Wheat	Canola	Pulses	Other Crops
1990	1609142	336114	58932	417451
1991	1687650	360990	81281	365977
1992	1474427	398852	91746	331398
1993	1566243	506904	116006	408927
1994	2180184	901960	205296	604586
1995	2308831	790197	247403	774173
1996	2372858	750127	257566	967850
1997	2412244	873380	245219	895238
1998	1871293	1118685	303247	747181
1999	1597931	784034	377813	625159

Data provided by Saskatchewan Agriculture and Food, Statistics Branch.

Table 4-A Yield Data

Yield data in kg/acre

Pea Yields

Canada	905
Uruguay	912
Finland	914
Poland	921
Hungary	942
United States	1001
Lebanon	1010
New Zealand	1270
Switzerland	1630
European Union	1727
Saskatchewan	856

Lentil Yields

China	519
Argentina	522
Australia	536
Canada	540
France	569
United States	580
Greece	596
Egypt	667
Lebanon	818
New Zealand	891
Saskatchewan	534

Table 4-A Yield Data, continued

Chickpea Yields

Italy	465
Greece	524
Israel	572
Mexico	589
Sudan	657
Cyprus	658
Egypt	743
Peru	783
Lebanon	930
China	1130
Canada	336
Saskatchewan	336

Bean Yields

United States	748
Poland	764
Greece	772
France	881
Malta	926
Lebanon	970
Egypt	1007
Netherlands	1123
Belgium-Luxembourg	1419
Ireland	1861
Canada	742
Saskatchewan	892

Data (excluding Saskatchewan) taken from the FAO Crops Primary, Agricultural Production Database. Website accessed December 8, 2000.

Saskatchewan data provided by Saskatchewan Agriculture and Food.

Table 5-A Land Distribution (Harvested Area, Thousands of Acres)

	Wheat	Canola	Pulses	Summerfallow	Other Crops
1990 - 1999 Average	17637.9	4873.9	1648.9	12076.7	7094.2
2000	15115	5850	4020	8400	8115
2005 Projection	12803.5	6910	6075.5	5750	8414
2010 Projection	10492	7970	8131	3100	8713

Data for the "1990 - 1999 Average" and "2000" were provided by Saskatchewan Agriculture and Food. The "2005 Projection" and the "2010 Projection" were calculated based on trends seen in land use in Saskatchewan from 1995 to 2000.

For this calculation, "wheat" consisted of winter wheat, spring wheat, and durum. "Pulses" consisted of lentils, dry peas, faba beans, and chick peas. "Other crops" consisted of oats, barley, fall rye, spring rye, flax, mixed grains, mustard seed, sunflower seed, canary seed, triticale, and safflower.

Table 6-A Pulse Exports, The World and Canada

All data in Mt

Total Pulse Exports

	World	Canada
1990	6,626,000	375,095
1991	6,703,052	433,205
1992	6,248,537	637,843
1993	7,084,739	839,402
1994	7,816,379	1,067,609
1995	8,015,025	1,487,120
1996	6,885,074	1,275,667
1997	6,917,897	1,304,593
1998	7,187,330	1,688,668

Table 6-A Pulse Exports, The World and Canada, continued

Pea Exports

	World	Canada
1990	2,702,557	163,986
1991	2,753,557	195,127
1992	2,371,920	296,919
1993	2,996,557	501,778
1994	3,005,958	683,524
1995	3,703,570	1,051,030
1996	2,725,800	852,951
1997	2,749,933	870,271
1998	3,166,633	1,135,202

Lentil Exports

	World	Canada
1990	519,678	116,327
1991	423,310	149,390
1992	575,374	222,181
1993	693,424	257,120
1994	843,640	260,442
1995	645,879	285,364
1996	816,444	284,813
1997	693,275	300,846
1998	736,779	374,118

Table 6-A Pulse Exports, The World and Canada, continued

Chickpea Exports

	World	Canada
1990	446,637	37
1991	587,230	43
1992	427,460	4,688
1993	541,589	379
1994	452,012	320
1995	309,234	917
1996	587,379	546
1997	775,216	864
1998	495,136	12,310

Bean Exports

	World	Canada
1990	2,048,425	91,916
1991	1,896,491	85,430
1992	1,938,065	111,249
1993	2,056,615	71,843
1994	2,487,226	117,870
1995	2,529,261	141,903
1996	2,142,310	133,515
1997	2,143,941	130,668
1998	2,285,503	164,900

Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed November 27, 2000.

Table 7-A Top Exporting Countries, Pulse Crops

All data in Mt

Exports, Total Pulses, Top 5 Countries

	Canada	France	China	Australia	United States
1993	839,402	1,291,717	823,935	719,260	489,545
1994	1,067,609	898,331	1,485,397	674,457	599,307
1995	1,487,120	1,092,987	1,054,259	249,873	594,630
1996	1,275,667	918,290	554,079	659,790	544,786
1997	1,304,593	846,136	599,905	796,024	539,061
1998	1,688,668	1,122,938	479,009	513,638	713,278

Exports, Peas, Top 5 Countries

	France	Canada	Australia	Ukraine	United States
1993	1,270,258	501,778	353,480	4,700	102,930
1994	875,237	683,524	340,961	93,500	122,161
1995	1,056,854	1,051,030	128,144	528,000	112,235
1996	883,127	852,951	291,919	47,561	117,234
1997	821,338	870,271	274,221	115,887	99,678
1998	1,096,214	1,135,202	197,216	115,887	127,229

Exports, Lentils, Top 5 Countries

	Canada	Turkey	Syrian Arab Republic	United States	China
1993	257,120	215,508	7,604	58,394	42,815
1994	260,442	293,218	67,458	80,787	74,725
1995	285,364	140,423	28,043	87,575	48,486
1996	284,813	246,142	160,665	54,646	11,808
1997	300,846	127,150	133,588	52,594	17,862
1998	374,118	154,010	55,600	53,234	26,315

Table 7-A Top Exporting Countries, Pulse Crops, continued

Exports, Chickpeas, Top 5 Countries

	Australia	Turkey	Mexico	Syrian Arab Republic	United States
1993	228,458	202,010	33,909	52,509	2,619
1994	220,714	102,510	63,782	42,450	5,817
1995	36,549	123,845	88,217	11,926	14,019
1996	216,666	192,710	136,835	1,303	7,890
1997	379,735	263,189	97,590	173	6,332
1998	164,555	157,890	110,696	3,600	10,318

Exports, Beans, Top 5 Countries

	Myanmar	United States	Argentina	Canada	Thailand
1993	535,900	312,122	166,428	71,843	90,361
1994	400,200	374,468	191,087	117,870	74,923
1995	609,600	373,264	180,065	141,903	46,256
1996	602,400	354,486	154,981	133,515	36,533
1997	400,000	369,116	302,863	130,668	20,925
1998	500,000	496,150	303,924	164,900	18,908

Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed December 6, 2000.

Table 8-A Top Importing Countries, Pulse Crops

All data in Mt

Total Pulse, Imports, Top 5 Countries

	Spain	India	Netherlands	Belgium-Luxembourg	Italy
1993	667,828	650,246	742,740	440,782	337,897
1994	748,411	582,124	719,125	519,731	419,884
1995	830,096	502,030	776,151	675,201	552,667
1996	589,146	692,431	613,486	661,110	386,601
1997	636,294	910,840	450,701	538,205	379,574
1998	784,076	780,656	594,155	600,711	407,194

Peas, Imports, Top 5 Countries

	Netherlands	Belgium-Luxembourg	Germany	Spain	India
1993	630,230	409,941	506,207	393,409	198,525
1994	627,747	485,105	467,227	435,952	144,964
1995	705,712	642,192	424,967	555,915	173,038
1996	558,421	635,857	222,728	331,970	154,530
1997	364,720	513,127	140,973	425,270	154,000
1998	512,456	578,815	130,590	560,596	294,000

Lentils, Imports, Top 5 Countries

	Egypt	Sri Lanka	Spain	India	Algeria
1993	65,561	43,048	66,419	2,351	20,055
1994	64,305	43,485	73,082	60,817	73,930
1995	31,648	62,495	66,519	26,736	31,672
1996	77,728	55,990	58,395	66,483	47,966
1997	76,582	83,186	46,904	66,483	43,860
1998	80,481	83,186	51,964	66,483	49,000

Table 8-A Top Importing Countries, Pulse Crops, continued

Chickpeas, Imports, Top 5 Countries

	India	Pakistan	Spain	Bangladesh	Algeria
1993	150,181	180,069	42,108	52,346	20,717
1994	58,127	82,936	50,520	65,342	14,078
1995	13,662	31,156	48,924	2,700	17,809
1996	122,061	75,795	74,337	7,202	43,941
1997	341,000	20,190	50,342	19,767	39,804
1998	92,000	21,005	41,291	22,137	27,000

Beans, Imports, Top 5 Countries

	Japan	Brazil	United Kingdom	Mexico	India
1993	116,468	79,821	119,931	7,571	54,177
1994	204,053	219,002	115,819	57,510	110,576
1995	154,107	171,762	117,733	26,062	92,847
1996	127,969	82,413	131,116	130,780	70,184
1997	137,981	158,474	131,366	90,161	70,184
1998	129,452	211,030	123,852	202,005	49,000

Data taken from the FAO Crops and Livestock, Primary and Processed, Agriculture and Food Trade Database. Website accessed December 7, 2000.

Table 9-A Food Balances, Per Capita Supply, 1998

	Per Capita Supply, Kg/Year
Tanzania	11.5
Ethiopia	11.9
Trinidad and Tobago	12.7
Malawi	12.9
Turkey	13.5
Uganda	14.1
Comoros	14.3
Lebanon	14.5
Mexico	14.7
Brazil	16
Eritrea	16.3
Nicaragua	17.5
Niger	19.1
Rwanda	28.5
Burundi	45.5

Data taken from the FAO Food Balance Sheets Database. Website accessed December 7, 2000.

Table 10-A Projected Population Growth, Pulse Markets, (In 1000s)

	Africa	South America	India	China
1970	357038	192426	554911	834871
1975	405880	216140	620701	932457
1980	466613	242303	688856	1004168
1985	536356	268747	767842	1075936
1990	614771	295085	850785	1161382
1995	696963	320550	933665	1227170
2000	784442	345780	1013662	1284958
2005	875662	370670	1087459	1334248
2010	973317	394941	1152164	1380973
2015	1077796	418405	1211665	1425921
2020	1187418	440422	1272166	1462735
2025	1298308	460866	1330449	1488661
2030	1405923	479595	1382722	1504096

Data taken from the FAO Agricultural Data, Population Database. Website accessed December 15, 2000.

Table 11-A Domestic Utilization of Pulses, Food Vs. Feed, 1998

	Feed (1000 Metric Tonnes)	Food (1000 Metric Tonnes)
Egypt	113	541
Ethiopia	0	711
Indonesia	0	787
Germany	721	159
Spain	739	313
Australia	970	118
United States	3	1140
Pakistan	197	964
Turkey	367	870
Mexico	31	1404
Nigeria	411	1127
France	2087	125
Brazil	1	2652
China	2232	2130
India	1240	11240
Canada	411	163

Data taken from the FAO Food Balance Sheets Database. Website accessed December 11, 2000.

Table 12-A Top Export Markets for Canadian Pulse Crops, 1999

Values in thousands of Canadian dollars

Export Markets, Peas

Turkey	0.08
Algeria	1.9
Italy	5.2
Colombia	6.6
Belgium	9.1
United States	10.8
Bangladesh	35.1
India	48.2
Cuba	56.8
Spain	71.5

Export Markets, Lentils

Bangladesh	0.20
Cuba	2.1
United States	3.5
India	7.4
Belgium	8
Italy	11.2
Spain	12.9
Colombia	21.3
Turkey	26.9
Algeria	29.5

Table 12-A Top Export Markets for Canadian Pulse Crops, 1999, continued

Export Markets, Chickpeas

Belgium	0.07
Italy	0.5
Algeria	0.5
Colombia	0.5
Turkey	0.5
India	1.1
United States	1.4
Bangladesh	1.9
Spain	2.1

Export Markets, Beans

Venezuela	2.8
Dominican Republic	3.5
Japan	4.1
Portugal	5.7
Spain	7.9
Italy	10.6
Colombia	10.8
Cuba	23.2
United States	34.3
United Kingdom	34.6

Data from the Industry Canada Trade Data Online website, accessed December 12, 2000.

Appendix B - Pulse Crop Research Interview Guide

Name ____________________ Position ____________________
Organization ____________________ Location __________ Phone # __________
Interviewer __________ Date/Time __________ In-person ___ Phone ___

1. What is your main activity or business line?

Research ☐
Production ☐
Processing ☐
Marketing ☐
Government Services ☐
Management/Administration ☐
Teaching ☐
Handling/Transportation ☐
Other ____________________

2. Which pulse crops do you deal with and what are your areas of expertise (e.g., breeding, disease management, exporting, statistics, etc.)? Please check.

Pulse Crop	Yes/No	Areas of Expertise
White pea beans		
Colored beans		
Dry beans		
Field peas		
Lentils		
Faba Beans		
Chick Peas		
Others		

3. What are the strengths and weaknesses of the Saskatchewan pulse industry?

Strengths:

Weaknesses:

4. How would you rate the overall profitability, as measured in net return, of the Saskatchewan pulse crop industry compared with other agricultural alternatives? Please indicate profitability on a scale of 0 to 5, where 0 is not profitable and 5 is very profitable.

0 1 2 3 4 5

5. What do you see as the broad market trends/opportunities for Saskatchewan pulse crops over the next 5 to 10 years?

Opportunity/Trend	Yes/No	Applicable Crops
Continued market growth for pulse crops currently produced in Saskatchewan		
Opportunities to diversify into other pulse crops not currently grown in Saskatchewan		
Opportunities to diversify markets		
Growing value-added processing opportunities		
Declining market opportunities		
Other		

Comments

6. What do you think are the top five specific market opportunities for pulse crops over the next 5 to 10 years (e.g., new crops, new countries, different product form, quality specifications, domestic feed use, etc.)?

Comments

7. What do you see as the top five threats or constraints to growth in the Saskatchewan pulse industry (e.g., disease problems, prices, production expertise, quality, profitability, container supply, lack of research support, etc.)?

Comments

8. What new pulse crops should be tested for feasibility of adaptation to Saskatchewan soil/climatic conditions?

9. How important do you think market/consumer needs, wants and preferences currently are in establishing pulse crop research priorities? Please mark the current degree of importance on a scale of 0 to 5, where 0 is not important and 5 is very important.

0 1 2 3 4 5

10. How important do you think market/consumer needs, wants and preferences should be in establishing pulse crop research priorities? Please mark the desired degree of importance on a scale of 0 to 5, where 0 is not important and 5 is very important.

0 1 2 3 4 5

11. Do you think it makes sense to invest in future pulse crop research?

Yes ☐ No ☐

Why?

12. What do you think would be the benefits of investing in future Saskatchewan pulse crop research? Please be as specific as possible.

13. What do you think are the top future research needs of the Saskatchewan pulse industry? Please rate what you think should be the priority on the following research needs/issues/topics over the next 5 to 10 years (add others you think should be included). Rate the priority on a scale of 0 to 5 where 0 is lowest priority and 5 is highest priority. State rationale or reasons.

Research need/issue/topic	Priority	Rationale/reasons
Genomic research	0 1 2 3 4 5	
Breeding for yield increases	0 1 2 3 4 5	
Breeding for agronomic characteristics	0 1 2 3 4 5	
Breeding for disease resistance	0 1 2 3 4 5	
Breeding for market requirements/preferences	0 1 2 3 4 5	
Biotechnology techniques & procedures development	0 1 2 3 4 5	
Biotechnology applications	0 1 2 3 4 5	
New crops research and testing	0 1 2 3 4 5	

Research need/issue/topic	Priority	Rationale/reasons
Applied research and demonstration under different soil/climatic conditions	0 1 2 3 4 5	
Research on agronomic and cultural practices	0 1 2 3 4 5	
Research on chemical and pesticide use	0 1 2 3 4 5	
Production machinery and equipment research and testing	0 1 2 3 4 5	
Post harvest handling, transportation and storage	0 1 2 3 4 5	
Packaging and processing research	0 1 2 3 4 5	
Seed fractionation and component utilization research	0 1 2 3 4 5	
Processed product development	0 1 2 3 4 5	
Quality evaluation, research and grading	0 1 2 3 4 5	
Marketing and consumer research	0 1 2 3 4 5	
Economics, competitiveness and transportation research	0 1 2 3 4 5	
Other areas/topics	0 1 2 3 4 5	
	0 1 2 3 4 5	
	0 1 2 3 4 5	
	0 1 2 3 4 5	
	0 1 2 3 4 5	
	0 1 2 3 4 5	

14. Please indicate how large a role you think each of the following organizations should have in the future in conducting pulse crop research (add other suggested organizations). Indicate your preference on the extent of the role for each on a scale of 0 to 5 where 0 is the smallest role and 5 is the largest role. Indicate suggested research needs/issues/topics.

Organizations	Extent of role	Research need/issue/topic
U of S Crop Develop Centre & Crop Science Dept.	0 1 2 3 4 5	
U of S Ag & Bioresource Engineering Department	0 1 2 3 4 5	
U of S Microbiology and Food Science Department	0 1 2 3 4 5	
Prairie Feed Resource Centre	0 1 2 3 4 5	
POS Pilot Plant	0 1 2 3 4 5	
Prairie Agricultural Machinery Institute (PAMI)	0 1 2 3 4 5	
Saskatchewan Food Centre	0 1 2 3 4 5	
AAFC Saskatoon Research Centre	0 1 2 3 4 5	
NRC Plant Biotechnology Institute	0 1 2 3 4 5	
Saskatchewan Research Council	0 1 2 3 4 5	
AFIF Spoke Research/ Demonstration Network	0 1 2 3 4 5	
Private sector companies	0 1 2 3 4 5	
Producer organizations	0 1 2 3 4 5	
New organizational or institutional model	0 1 2 3 4 5	
Other organizations	0 1 2 3 4 5	
	0 1 2 3 4 5	
	0 1 2 3 4 5	
	0 1 2 3 4 5	

Comments, including any special reasons for your choices

15. How satisfied are you with existing collaboration and cooperation among the various institutions conducting pulse research in Saskatchewan? Please indicate your level of satisfaction on a scale of 1 to 5, where 1 is strongly dissatisfied and 5 is strongly satisfied.

Existing collaboration and cooperation 1 2 3 4 5

Comments

16. What suggestions do you have for improving collaboration and cooperation in future pulse crop research?

17. How should the sourcing of funds for future pulse crop research be shared? Please provide percentages and any rationale/reasons.

Funding Source	Share	Rationale/reasons
Producers		
Handlers/processors/transporters		
Marketers/Exporters/Brokers		
Provincial government		
Federal government		
Others		
Total	100%	

18. What criteria should be used for allocating future pulse crop research funding resources among needs/issues/topics/projects?

19. Overall, upon reflection, how satisfied are you with the current direction of and size of investment in pulse crop research in Saskatchewan? Indicate your level of satisfaction on a scale of 1 to 5, where 1 is strongly dissatisfied and 5 is strongly satisfied.

Current direction	1	2	3	4	5
Size of investment	1	2	3	4	5

20. What do you estimate should be the total annual expenditure (capital and operating combined) on Saskatchewan pulse crop research?

Please indicate the basis for your estimate

21. What expenditures are needed over the next 10 years to undertake future pulse research within your area of expertise? Indicate any rationale/reasons.

Category	Amount $	Rationale/reasons
Infrastructure investments		
Long-term operating funds		
Human resource investments		
Incremental project-linked funds		
Other		
Total		

Please elaborate on specifics, if possible

22. Are there any other areas/issues/aspects of the pulse crop industry that should have higher priority than research for public funding?

23. Do you have any other suggestions for improving the future, longer-term profitability and viability of the various facets of the Saskatchewan pulse crop industry (i.e., production, distribution, marketing, processing and utilization)

Appendix C - Letter of Intent

Canadian Pulse Research Initiative

The Concept:

To create an internationally recognized pulse research initiative realizing the full economic potential of the pulse crop industry (peas, lentils, beans and chickpeas) in Canada in both production and value-added processing. The full economic potential from pulse crops will be realized by:

1) maximizing the agricultural zones in Canada in which pulse crops can be competitively grown;

2) maximizing the positive environmental impact of the nitrogen fixation capabilities of pulse crops; and

3) leading the world in domestic and international market opportunities created and captured for pulse and pulse constituents.

The University of Saskatchewan will serve as the hub for a national network of pulse research and researchers. A number of relevant disciplines will collaborate within this initiative:

- agronomics
- animal nutrition and feed processing
- biotechnology
- breeding
- food processing
- microbiology
- pathology
- physiology
- soil science
- storage and handling (engineering)
- value-added products (constituent components)

This initiative will create the only research facility in the world dedicated to capitalizing on the economic and environmental opportunities presented by pulse crops. It will quickly become the world leader in pulse research with its multi-disciplinary research capabilities and world class research facilities.

Saskatchewan is the logical location for the initiative's hub due to its large concentration of pulse crop production, processing and research capacity. This proposal will build upon and enhance the human resource and research infrastructure already in place at the University of Saskatchewan. Research infrastructure will extend beyond the U of S to other participating institutions such as the University of Alberta, the University of Manitoba, Guelph University, Agriculture Canada and the Plant Biotechnology Institute. Incorporating a number of research agencies within one initiative will accelerate and enhance activities.

The Objective:

The objective of the initiative is to accelerate the growth and economic prosperity of a sector that has already been growing at 20% per year. Initiating this proposal will transform the way pulse research is done. Through a multi-disciplinary research approach, the Pulse Research Initiative will put, and keep, Canada in the forefront of pulse production, processing and market opportunities.

The Initiative will have the human and physical capital necessary to conduct research in every area of the pulse industry – from variety development and efficient and environmentally sustainable production to identifying and processing pulse constituents into value-added food, feed and nutraceutical products.

The Research:

The proposed Pulse Research Initiative has a long-term horizon (15 to 20 years). Over this time period research will evolve and dramatically change. By responding to the needs today, the industry will have the equipment and resources to effectively adapt to future needs. The research priorities for the next 5 to 10 years are:

1) Research, develop and incorporate molecular marker-assisted selection technology in breeding programs;

2) Research, develop and incorporate double haploid breeding technology for pulses in tandem with marker-assisted selection strategies;

3) Research, develop and incorporate improved pathology screening technology for major disease of concern in pulse crop breeding;

4) Research, develop and implement transgenic tools for pulse crop breeding in combination with marker-assisted selection technology;

5) Research, develop and implement a variety of agronomic selection technology for pulse crop breeding systems;

6) Research, develop and implement rapid assessment technology for the major quality characteristics of interest in pulse crop improvement including culinary, processing, chemical and hedonic traits;

7) Research, develop and integrate interspecific hybridization technology for use in genetic improvement of pulse crops;

8) Research, develop and implement breeding systems that will allow pulse crop breeding to compete with oilseed and cereal breeding systems, including refinement of adaptation to specific production zones across Canada; and

9) Research, develop and commercialize prototype products from and processes applicable to pulse crops thereby developing new uses and markets for Canadian grown pulses.

10) Research, develop and commercialize pulse varieties and pulse constituents for enhanced animal feed performance.

The Results:

The expected results from the creation of the Pulse Research Initiative are many and varied. The Institute is expected to create economic, environmental and human resource impacts.

Economic

1) New commercial opportunities for products and processing of pulse and pulse constituents.

2) A highly competitive pulse production sector (minimized input costs and maximized production).

3) Economic growth and job creation in the production, processing and value-added sectors of the pulse industry.

4) Efficient and optimal use of the research infrastructure through a multi-disciplinary approach and by promoting sharing and collaboration.

Environmental

1) Reduce reliance on and use of chemical based nitrogen fertilizers through novel nitrogen fixing, biological control and plant-growth promoting microbial strains.

2) Environmentally sensitive and effective integrated pest (weed, disease and insect) management strategies and pesticide free production of pulse crops.

3) Varieties and agronomic practices adapted to environmental conditions maximizing use of soil moisture and minimizing negative environmental impacts.

Human Resources

1) A research environment that fosters innovation in research methods, techniques and commercial products.
2) Training opportunities for over a 100 individuals over the next 15 years at the graduate and undergraduate level to take positions in research and private companies within the pulse industry.
3) The Institute and its facilities will attract and retain high calibre researchers in Canada.
4) Promote and foster collaboration among researchers throughout Canada and the world.